

TECHNOLOGY DEPT.

Chemical Age 7 February 1953

WITH METALLURGICAL SECTION

PUBLIC LIBRARY

FEB 20 1953

DETROIT

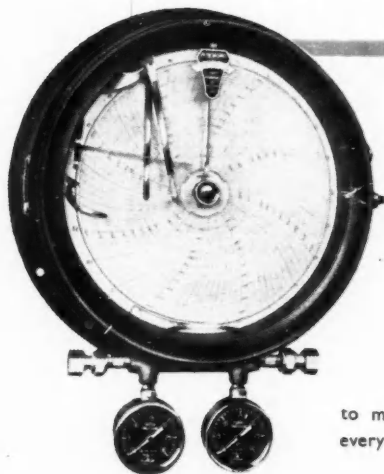
# The Chemical Age

VOL LXVIII

7 FEBRUARY 1953

NO 1752

## FOXBORO INSTRUMENTS

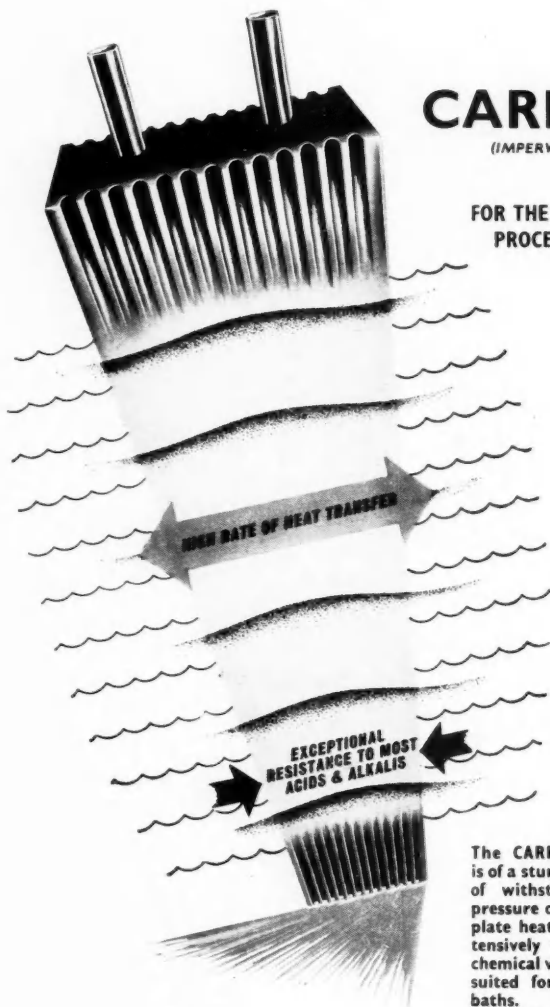


Chemical processes require for their successful operation instruments of proven accuracy and reliability. That Foxboro Recorders and Controllers satisfy these demands is evinced by the large number used throughout industry.

Foxboro Automatic Controllers are available in various models designed to meet the needs of practically every process application.

**FOXBORO-YOXALL, LIMITED**

MORDEN ROAD, MERTON, LONDON, S.W.19



## CARBINERT

(IMPERVIOUS GRAPHITE)

FOR THE CHEMICAL AND  
PROCESS ENGINEER

The  
**MORGAN CRUCIBLE**  
COMPANY LIMITED

The **CARBINERT** PLATE HEATER is of a sturdy construction capable of withstanding internal steam pressure of 40 lb/in<sup>2</sup>. This type of plate heater is being adopted extensively for heating all kinds of chemical vessels and is particularly suited for use in steel pickling baths. **CARBINERT** (Impervious Graphite) is a robust material with a high rate of heat transfer and has an exceptional resistance to most acids and alkalis.

Write for Booklet P.I.I giving further details of its uses.

BATTERSEA CHURCH RD · LONDON · S.W.11 Tel: BATTERSEA 8822 · Grams: CRUCIBLE, SOUPHONE, LONDON  
CH. 108A

RT

# The valve with the *world-wide* reputation



AUDCO Lubricated Valves are in daily use in the Chemical Industry throughout the world, where their effectiveness has been proved under the most adverse conditions. They handle almost all fluids and gases, whether corrosive or erosive, with equal efficiency and economy. The more recently developed Inverted Type Audco Valve shown above is recommended in place of the Standard Type on the larger-sized lines.

## AUDCO

*Lubricated*  
**VALVES**

Audley Engineering Co. Ltd., Newport, Shropshire

M-W7



**A NEW FIBREFREE FILTER PAPER—THE COMPLETE WET-  
STRENGTH EQUIVALENT OF THE STANDARD**

**POSTLIP**



**mill 633**

**EVANS ADLARD & CO. LTD. WINCHCOMBE GLOS.**

Makers of Industrial Filterings  
and Absorbent Base Papers.

## AIR BLOWERS FOR INDUSTRY



A highly efficient Blower for pressures up  
to 12 lb. per sq. inch. Capacities from 10  
up to 10,000 cu. ft. per minute.

Send for Brochure No. 30.

**W. C. HOLMES & CO. LTD., HUDDERSFIELD**

Telephone : 5280 (Six Lines)



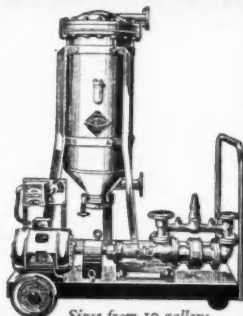


## INDEX TO ADVERTISERS IN THIS ISSUE

	Page		Page
Alumina Co., Ltd. (The)	xv	Hess Products, Ltd.	ix
Anderman & Co., Ltd.	xv	Holmes, W. C., & Co., Ltd.	ii
Audley Engineering Co., Ltd.	i	Kestner Evaporator & Eng. Co., Ltd.	xvi
Berk & Co., F. W., Ltd.	vii	Laporte Chemicals, Ltd.	iv
Blundell & Crompton, Ltd.	Cover iii	Leigh & Sons Metal Works	xvi
Boulton, Ltd., William	xv	Merthyr Tidfil Ceramics, Ltd.	xiv
British Carbo-Norbit Union, Ltd.	xvi	Metal Containers, Ltd.	Cover iv
British Drug Houses, Ltd.	259	Metafiltration Co., Ltd. (The)	iii
British Oxygen Co., Ltd.	x	Morgan Crucible Co., Ltd. (The)	Cover ii
Clark & Co., T. & C.	viii	Orr, George W., & Co., Ltd.	Cover iii
Clayton, Son, & Co., Ltd.	xi	Penrhyn Quarries, Ltd.	263
Classified Advertisements	264, xiii, xiv	Permutic Co., Ltd. (The)	261
Derby Aviation, Ltd.	xvi	Robinson & Co., Ltd. L.	vi
Dryden, T., Ltd.	xii	Sandiacre Screw Co., Ltd.	xiii
Evans Adlard & Co., Ltd.	ii	Sutcliffe, Speakman & Co., Ltd.	v
Foxboro-Yoxall, Ltd.	Front Cover	Tack Air Conditioning, Ltd.	vi
Gethings & Son, B.	Cover iii	Wilkinson, James, & Son, Ltd.	viii
Greenwich Pump & Plant Co. (The)	xvi	Wilson, Edward, Ltd.	xvi
Guest Industrials, Ltd.	iv, xv	Wood, Harold, & Sons, Ltd.	xvi
Harris (Lostock Gralam), Ltd.	Cover iii		
Haughton's Metallic Co., Ltd.	xvi		

## Starbright Filtrates

In one mechanical operation the Metafilter filters out every trace of solid matter. Cleaning by reversal is equally simple — no filter cloths to clean — no expensive filter pads to replace. A sound engineering job in stainless steel — monel metal — copper or steel.



Sizes from 10 gallons to 10,000 gallons per hour.

# METAFILTRATION

PHONE:  
HOUNSLOW 1121/2/3  
GRAMS:  
METAFILTER, HOUNSLOW

THE METAFILTRATION COMPANY LIMITED, BELGRAVE ROAD, HOUNSLOW, MIDDLESEX



The Cornish Cheesewring at Liskeard existed at least 300 years ago, yet nobody knows how it came to be assembled in this remarkable way. Laporte hydrogen peroxide has a characteristic in common with the Cheesewring—stability. The stability of hydrogen peroxide is largely due to its high purity.

Hydrogen peroxide is a concentrated source of active oxygen. Already widely known as a bleaching agent, its oxidising properties have led to its increasing use in organic syntheses and other chemical reactions. Our Sales Service and Development Department will be pleased to give advice on the applications of hydrogen peroxide.

## HYDROGEN PEROXIDE BY LAPORTE



**LAPORTE CHEMICALS LTD., LUTON**

Telephone: Luton 4390 Telegrams: Laporte Luton



## AB BOFORS NOBELKRUT

*can now offer for prompt shipment :*



In addition, their wide range of other Chemical and Pharmaceutical products include:—

2,4-Dinitro toluene; Para Nitro Benzoic Acid  
ortho-Toluene sulphonamide; para-Toluene  
sulphochloride; Formaldehyde; Chloramine-  
T; para-Aminobenzoic acid B.P.; Phenol;  
Procaine Hydrochloride B.P., etc., etc.

**AB BOFORS NOBELKRUT : BOFORS : SWEDEN**

*Write for samples and prices to the Sole Selling Agents:*

**GUEST INDUSTRIALS LTD.**

*Raw Materials Division*

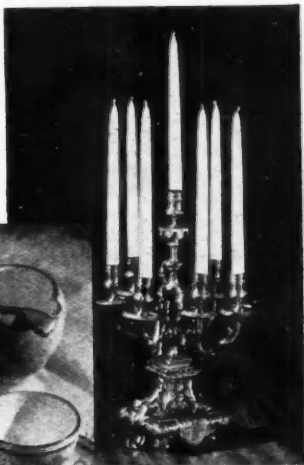
81 GRACECHURCH STREET, LONDON, E.C.3.  
Telephone: MANSION House 5631 (18 lines). Tele-  
grams: Guestind, London. Sub-Agents in Scotland:  
H. M. Roemmele & Co. Ltd., 65 West Regent Street,  
Glasgow, C.2. Sub-Agents in Australia: John  
Beith & Co. Pty. Ltd., Melbourne and Sydney.



**A Harris and Dixon Company**

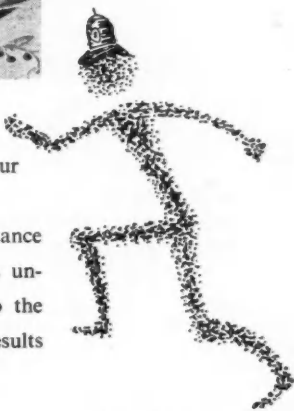
## THE WHITENESS OF CANDLES AND SUGAR

If Active Carbon can transform a grey and spluttering candle into a white, clear-burning candle, refine and decolourise sugar, reclaim dry cleaning solvents and



remove noxious odours from the atmosphere itself—what might it not undertake in your particular line of business?

The high adsorption of this high-minded substance accounts for the removal of much that is unpleasant to the senses and unprofitable to the manufacturer . . . the process is simple, the results attractive.



**SUTCLIFFE  
SPEAKMAN**

THE ACTIVE CARBON SPECIALISTS ARE

**SUTCLIFFE SPEAKMAN AND COMPANY LIMITED, LEIGH, LANCASHIRE**

Telephone: Leigh 94. London Office: 2, Caxton Street, Westminster, S.W.1 Telephone: Abbey 3085



**EITHER IT IS — or it isn't!**

*JUBILEE has been our registered trade name for 30 years, and may not be used to describe any other clip.*

**THE FINEST CLIP** *in the world*

**L. ROBINSON & CO., (GILLINGHAM) LTD.,** *London Chambers GILLINGHAM. KENT. PHONE 5742*  
L 3262 K

## *Ozone may solve YOUR problem*

Daily our LABORATORY AND INDUSTRIAL OZONISERS are helping to solve many problems, including

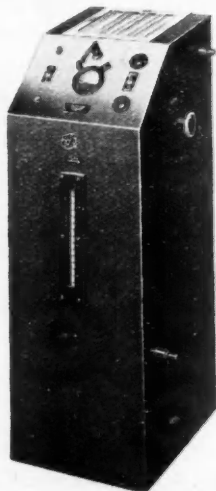
- ORGANIC OXIDATIONS
- STERILISATION OF LIQUIDS
- REMOVAL OF UNWANTED ODOURS  
Etc., Etc.

We manufacture a range of OZONE GENERATORS which have been specially designed for experimental and small scale industrial use. The Units are self-contained, and the larger models are equipped with an air dryer in order to maintain a constant ozone output.

Our Research Department, with over 50 years' experience in developing ozone apparatus, will be pleased to advise you without obligation.

### **TACK AIR CONDITIONING LTD.**

**Ozonair House, Longmoore Street, London, S.W.1.**  
Telephone : VICToria 5001.





*Branches at*  
81, Fountain Street, Manchester, 2  
65, West Regent Street, Glasgow, C.2  
40, Queen Street, Belfast, N.I  
Morrison, Nr. Swansea, S. Wales

# Ask Berk

*for*

**Acids  
Chemicals  
Drugs and Botanicals  
Filter Aids, Bentonites  
and Zircon  
Mercurials  
Metal Powders  
Pneumatic Drying  
Installations  
Protective Coatings**



Phone : CHAncery  
6041 (16 lines)

**F. W. BERK & Co. Ltd.**  
**COMMONWEALTH HOUSE,**  
**1-19, NEW OXFORD STREET,**  
**LONDON, W.C.1.**

# HYDROFLUORIC ACID

**ANHYDROUS AND SOLUTIONS ALL STRENGTHS  
ALSO PURE REDISTILLED 40% w/w**

## FLUORIDES, Neutral

Sodium, Magnesium, Barium,  
Potassium, Lead, Zinc, Ammonium,  
Aluminium Lithium, Chromium.

## BiFluorides (Acid)

Ammonium Sodium, Potassium.

## Double Fluorides (Cryolites)

Sodium HexafluoroAluminate  
Potassium HexafluoroAluminate

## SILICOFLUORIDES

Magnesium, Zinc, Ammonium,  
Barium, Potassium, Lead,  
Hydrofluosilicic Acid.

## BOROFLUORIDES

Sodium, Potassium, Ammonium,  
Lead, Copper, Zinc, Cadmium,  
Fluoboric Acid Solution.

OTHER FLUORIDES TO SPECIFICATIONS.

Glass Etching Acids

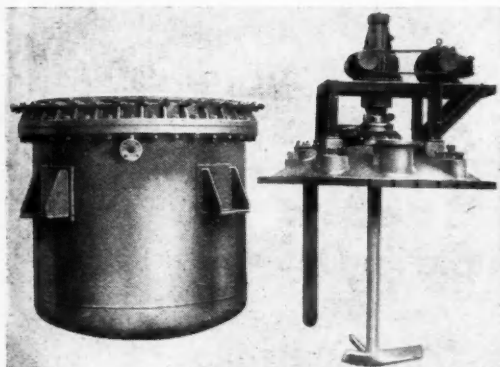
Ammonia White Acid and VITROGRAPHINE.

## JAMES WILKINSON & SON, LTD.

TINSLEY PARK ROAD, SHEFFIELD, 9

'Phone 41208/9

'Grams "CHEMICALS" Sheffield



## ENAMEL LINED EQUIPMENT

Concentrators, Mixers, Evaporators, Digestors, etc., in Cast Iron or Steel. Lined with Hard Acid Resisting Glass Enamel guaranteed free from Lead or Antimony.

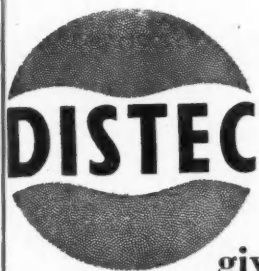
## T. & C. CLARK & CO. LTD.

SHAKESPEARE FOUNDRY, WOLVERHAMPTON

Telegrams : Clarke, Wolverhampton

Telephone : 20204/5

*Established over a Century and a Half*



gives you **PURITY**  
and

90%

## LOW IODINE VALUE in these FATTY ACIDS



Caprylic C<sub>7</sub> H<sub>15</sub> COOH  
Capric C<sub>9</sub> H<sub>19</sub> COOH  
Lauric C<sub>11</sub> H<sub>23</sub> COOH  
Myristic C<sub>13</sub> H<sub>27</sub> COOH  
Palmitic C<sub>15</sub> H<sub>31</sub> COOH  
Stearic C<sub>17</sub> H<sub>35</sub> COOH  
Behenic C<sub>21</sub> H<sub>43</sub> COOH

Also Available:

Caprylic-Capric  
Commercial Stearic  
Mixed Unsaturated Acids

### WE'RE GLAD TO MEET PEOPLE WITH PROBLEMS

How often we talk to people with *special* processes needing *special* fatty acids! And as many times, we're pleased to say, we are able to supply just the formulae they require . . . specially made up if necessary. Let us call on you right away for a discussion of your *own* problem.

For fully descriptive catalogue, prices and samples, write to the manufacturers:

**HESS PRODUCTS LIMITED, 4 ALBION STREET, LEEDS, 1**  
LEEDS 22827

MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL  
 MELAMINE MELAMINE MELAMINE MELAMINE MELAMINE  
 NE MELAMINE MELAMINE MELAMINE MELAMINE MEL

**B.O.C**  
**MELAMINE**  
*provides:*

**Adhesives** that are strong,  
 colourless and boilproof.

**Laminates** with surfaces that  
 are transparent, mar- and solvent-  
 proof and resistant to heat and steam.

for supplies and prompt service write to:

CHEMICALS DIVISION

**THE BRITISH OXYGEN CO LTD**

VIGO LANE CHESTER-LE-STREET CO. DURHAM

Telephone: BIRTLEY 145





# The Chemical Age

Established 1919

The Weekly Journal of Chemical Engineering and Industrial Chemistry

BOUVERIE HOUSE 154 FLEET STREET LONDON E.C.4

Telegrams: ALLANGAS FLEET LONDON • Telephone: CENTRAL 3212 (26 lines)

Volume LXVIII

7 February 1953

Number 1752

## Synthetic Rubber ?

**A**T some not too distant date a British start in synthetic rubber production must surely be made.' We are quoting our own comments (CHEMICAL AGE, 66, 461-2), a dangerously senile habit, but we have been prompted to take this risk by learning that some preliminary discussions on the establishment of a synthetic rubber plant in Scotland have taken place. It is reported that the Ministry of Supply, the Scottish Council for Development and Industry, the National Benzole Association, and a large rubber company took part. If information that has recently been published is correct, two conclusions have been reached: (1) there is full agreement that British synthetic rubber production is desirable, and (2) the practical obstacles are at present much too formidable.

In our view the *raison d'être* for British synthetic rubber is single and simple—do we or do we not need a second source of supply? Whether, in fact, we do must be a combined decision of military, economic, and political opinion. This basis for agreement or disagreement on a national synthetic rubber

project is not quite the same as that of discussions between a single Government department, petro-chemical interests, a rubber-using company, and a regional development council. It cannot be assumed, therefore, that the agreement said to have been reached in these discussions is in any way a national or official acceptance in principle of the case for synthetic rubber production. In any case, the practical verdict seems to have been oppressively negative. Even the smallest economic size of a synthetic rubber plant is large. Although, as we said in 1952, 'the production of synthetic rubber would dovetail neatly with the chemicals-from-petroleum industry and with post-war expansion in oil refinery capacity,' it is reported that no single refinery or petro-chemical plant can supply all the raw materials needed by a minimum-sized rubber plant. Secondly, very large investments of capital will be required. The only feasible solution is the formation of a co-operative venture like that of the United Sulphuric Acid Corporation, financed and managed, technically and commercially, by oil refiners, chemical manufacturers,

and rubber processors. The prospects of this approach, however, are considered remote and likely to remain so until the refinery expansion scheme has been completed and petro-chemical supplies are much greater. The basic difficulty is clearly enough the inability, so far as is at present known, to operate a small synthetic rubber plant economically. In urging last year 'no more than a limited target of production, a prototype for ready expansion if our main supplies . . . ever became uncertain . . .', we ignored this difficulty. But is it not a problem that might be overcome by our own research and technological efforts? The post-war revival of German rubber production has been associated with an output of 500 tons a month and sometimes even less; the costs have been higher than those of larger-scale output and it is said that something like a 40-fold expansion will be needed to enable German rubber to compete with U.S. rubber. Nevertheless, unlikely technological problems have sometimes been cracked by research that is aimed at a single purpose.

Too much guidance should not be taken from U.S. synthetic rubber economics. It has long been the charge of natural rubber interests that the U.S.

product has been sold at subsidised prices. To quote from a recent issue of *The Economist* (24 January, 1953, p. 238): 'The industry as owned by the Government enjoys certain advantages that private manufacturers would not obtain; for example, it is getting part of its supplies of styrene under long-term contract, at well below market prices.' The factories are likely to be handed over to private companies during 1953, perhaps by lease, more probably by sale. The price of American synthetic rubber very much depends upon the terms at which the Government-built plants change ownership. If sales take place at heavily written-off capital values, synthetic rubber will remain in effect subsidised. But sales at realistic figures may lead to a rise of from 10 to 30 per cent in the price of synthetic rubber. The huge U.S. rubber-producing industry has been, and still is, a Government-funded and Government-run enterprise. It has yet to face the profit-or-loss tests of private ownership and operation.

The fact that the synthetic rubber industry would form the nucleus of a valuable new branch of chemical industry should be only a secondary consideration.

## On Other Pages

<i>Poland's Progressive Chemical Industry</i>	233	<i>Electrodeposition of Zinc-Tin Alloy</i>	253
<i>Precious Metal Assaying</i>	235	<i>Home News Items</i>	255
<i>Fruit &amp; Vegetable Storage</i>	241	<i>Overseas News Items</i>	256
<i>Power-Gas Annual Meeting</i>	245	<i>Personal</i>	257
<i>Metallurgical Section:</i>		<i>Publications &amp; Announcements</i>	258
<i>High Temperature Experiments with Zirconium</i>	247	<i>Next Week's Events</i>	260
<i>Machining Rare Metals</i>	250	<i>Market Reports</i>	262
<i>Production of High-Purity Lead</i>	251	<i>Law &amp; Company News</i>	263

The annual subscription to THE CHEMICAL AGE is 42s. Single copies, 1s.; post paid, 1s. 3d. SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3954/5). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham (Midland 0784/5). LEEDS OFFICE: Martins Bank Chambers, Park Row, Leeds, 1 (Leeds 22601). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers Limited.

## Notes & Comments

### The RIC Journal

AT a time when the continuation of a major publishing activity of our chemical societies is in some doubt, the sudden expansion of one of the country's oldest professional journals is both surprising and welcome. This is the Royal Institute of Chemistry's *Journal*, which begins monthly publication after so long an existence as a quarterly. Appropriately the change has been made with the first issue for 1953 and, if 'January, 1953' of Volume 77 is a true sample of future production, the Fellows and Associates of the Institute will not receive a less considerable journal as a result of its trebled frequency of appearance. It is no secret that Dr. Ellingham, the Secretary and Registrar, has devoted a great deal of time and thought to the *Journal* and its improvement, but paper shortage and rising costs of printing and labour, have previously held back the essential, physical means of improvement. Now some easement in paper costs together with revenue from a moderate inclusion of advertisements enables the long-planned developments to go forward.

### Regular Features

MUCH of the extra space will be devoted to professional aspects of chemistry, a correctly logical expression of the Institute's principal purpose. The series of articles on 'The Chemist and his Work,' already begun in previous quarterly issues, will become a regular feature. Chemical education topics will be given much increased attention, and Dr. F. J. Smith's study of the delicate reactions between examiners and examinees in the first monthly issue sets a practical standard that may in fact be hard to emulate. And a new series deals with the history of the great schools of chemistry in this country. All chemists will wish the *Journal* well in its new phase of life. Looking back to the easier pre-war years it is perhaps possible to feel that the

*Journal* then was a less than adequate expression of the Institute's importance and status. That defect, if it was one, has now been removed.

### Zirconium

ONE consequence of atomic energy development is likely to be a much greater interest in the metallurgy of zirconium. Zirconium has exceptionally good resistance to a wide range of corrosive chemicals, including that bugbear of many metals, wet chlorides. It has a high melting point, 1,857°C. It has a low neutron absorption capacity. This combination of resistance to chemical, thermal, and neutron attack makes zirconium a natural choice for special constructional uses in nuclear reactors. In America the Atomic Energy Commission guaranteed a contract for five year's output of zirconium to any company prepared to erect a plant to produce the pure metal. According to a recent account in *Chemical Week* (1953, 72, 2, 32-36), such a contract was eventually settled and the requisite plant is at present nearing completion. 150,000 lb. of zirconium and hafnium sponge will be annually made for the AEC.

### Process Still Secret

THE process used is based on the most prolific mineral source, zircon. This is converted into the carbide, which is then chlorinated to form crude zirconium tetrachloride. The difficult separation of the sister element, hafnium, is achieved at this stage by a process still classified as secret by the AEC. The product is pure zirconium oxide. This is then mixed with carbon black as a reducing agent, and the mixture, in the form of briquettes, is chlorinated to yield pure zirconium tetrachloride. Magnesium is then used in an electrically heated furnace to displace pure zirconium from its association with chlorine. It is said that hafnium-free zirconium metal will

be sold to the AEC at less than \$15 per lb. Current market prices in America for high purity zirconium are \$65 per lb. or more. Whether this new development will bring about a general reduction in the price of zirconium remains to be seen; if so, the metal may expand its range of industrial uses, particularly in the field of corrosion-resistance.

## Oil Refineries Damaged

### Flooding Halts Production

THE Thames oil refineries in their vulnerable positions on reclaimed tidal land have been inundated by the floods.

Coryton, the refinery of the Vacuum Oil Company, which had just begun production on the Saturday afternoon before the floods started, was the first to be affected. Staff on duty in the early hours of Sunday morning only had a quarter of an hour to stop production at the plant and evacuate. Production is likely to be held up for several weeks.

At Shell Haven, waters first flooded the East site pump houses, and a few hours later there was three feet of water in the refining unit. On Tuesday the West site was still operating although water was seeping across.

At both refineries worse damage was avoided as they were closed down by intention and not by the action of the water which would have caused far more harm and made re-starting operations, when possible, far more difficult.

It is impossible at present to estimate damage, but electrical equipment has been soaked and communications broken. A film of oil on the water will leave a residue of filth and corrosion will inevitably result.

Severe damage has also been sustained at the new refinery of the Anglo-Iranian Oil Company on the Isle of Grain, Kent. One of the chief items of plant to be affected is the water pump-house. When the refinery 'comes on stream' this would be required to pump 3,500,000 gallons of water a day. Travel by either road or railway has been impossible and officials have visited the site by tugs.

The Isle of Grain refinery was scheduled to be in full production by this summer, but this will inevitably have to be delayed as a result of the floods, although the full extent of the damage is not yet known.

## Nitrogen Fixation

### Balance a Matter of Prime Importance

THE world's nitrogen account is going into the red,' Robert H. Burris, professor of biochemistry at the University of Wisconsin, said on 29 December at a symposium on biological nitrogen fixation at the annual meeting of the American Association for the Advancement of Science.

'As nitrogen, more frequently than any other element, limits agricultural production, biological nitrogen fixation has an importance secondary only to photosynthesis in the world's agricultural economy,' Professor Burris added. 'Biological nitrogen fixation is of prime importance in maintaining the world's nitrogen balance for man dissipates nitrogen to the sea and air at a far greater rate than he fixes nitrogen chemically from the air.'

Scientists knew some of the steps in the complicated fixing process, but the current stumbling block was the first few steps. How nitrogen from the air was first fixed into the bacteria was now the main concern.

'Much evidence has been accumulated recently to show that ammonia is the key intermediate in the fixation process,' Professor Burris said. 'This is not to imply that ammonia is the first intermediate in fixation, for there are undoubtedly one or more compounds between it and nitrogen. The importance of ammonia arises because it is the compound which combines with the carbon chains to form organically bound nitrogen.'

### Nitrogen Fixing Bacteria

Professor Burris pointed out that it had been possible for the first time recently to get the bacteria in leguminous root nodules to fix nitrogen in the laboratory away from the plant to which they were attached. 'This offers a simplified system for the study of symbiotic nitrogen fixation, as the intact plant can be replaced by the detached nodule as the object of study,' he said. 'The application of isotopic tracers and other new techniques has added much to our knowledge of biological nitrogen fixation during the past decade. The next decade promises much additional information in this process which is so vital to maintenance of the world's agricultural economy.'

# Poland's Progressive Chemical Industry

## Expansion Under the Six-Year Plan

*Probably more than most countries in Europe, Poland has not only recovered but has rapidly advanced to a position that leaves the pre-war standard a long way behind. This is the opinion of experts who have made a detailed study and as will be seen from the following report, which is based on a full and detailed report of the progress achieved and developments expected in the more important sections of chemical and metallurgical industries. It was written by Dr. Alfons Metzner, of Frankfurt/Main, editor of 'Chemische Industrie.' We are indebted to Dr. Metzner for offering permission for summarising his article, which appeared in the January issue of his journal.*

**P**RACTICALLY all industry, agriculture, and trade in Poland is nationalised, and particular attention has been directed to the chemical sections as occupying key positions in economic, military, and social stability. The six-year Plan began in 1950, and by 1952 chemical output had already reached U.S. \$1,000,000,000.

Much attention is being directed to standardisation and to research. There is said to be an increasingly closer relation between scientific institutes and industry, with accelerated application of new apparatus and processes, and study of foreign developments. At the beginning of 1952 six new research institutes were inaugurated—three in Warsaw for dyes and intermediates, plastics, and drugs; one in Gleiwitz for inorganic chemistry, one in Auschwitz for organic synthesis; and one in Lodz for cellulose.

### Good Supply of Coal

The primary and basic material for all industry—coal—is in good supply, and output is to be raised from 85,000,000 in 1952 to 100,000,000 tons in 1955. The most important coalfields are in Upper Silesia, but this is not good coking coal. For the coke and gas industry the chief supplies are from Rybnik, Gleiwitz, and Zabrze. The Waldenburg fields too are valuable in this respect, with estimated reserves of 1,500,000,000 tons, on the basis of which the coking, low temperature carbonisation,

and coal chemical industries are to be further developed. Of the total estimated coal output in 1955, these and especially the low temperature carbonisation plants will take 20,000,000 tons. Many new plants are being erected for synthesis gases, coal chemicals and so on.

### Administration Established

In 1952 the Zentral-Verwaltung für Kohlenchemie (Central Administration for Coal Chemistry) was established. Among other things it is interested in a semi-industrial process for carbazol and phenanthrene, and in a new method for the production of high percentage anthracene. The first low temperature coking plant was built at Auschwitz in July, 1951, and another is under construction at Konin for brown coal or lignite. At the former (Auschwitz) the large works for organic synthesis comprises three main parts: (a) synthetic fuels by the Fischer-Tropsch process, plants for methanol, acetic acid and so on, for which ultimately 1,000,000 tons of coal a year will be used; (b) low temperature carbonisation, coal chemicals, synthetic gas; (c) calcium carbide and acetylene chemicals. At these and two other works (Blechhammer and Heydebreck or Kedzerzin) 100,000 tons liquid fuels is being produced at present, and will be rapidly increased.

Petroleum refineries are now producing annually about 500,000 tons motor fuel from home and imported crude. Home yield of crude is to be raised to about 400,000 tons by 1955, of which about one-fifth will be obtained from part of the Drohobycz field restored to Poland by Russia. Home reserves of lignite are estimated at approximately 15,000,000,000 tons, in the Grünberg, Posen, Bromberg, and Lodz regions. Those in Lower Silesia are only slowly recovering from war damage. Others, as those in Konin are to be extensively worked for chemical products, for example, up to 8,500,000 tons lignite in 1955. Poland is also rich in peat beds, production of which is to be multiplied fourfold by 1955, including manufacture of various chemicals in addition to the conventional uses of peat. A

Peat Research and Development Institute has been established.

Another basic factor in industrial revival is an efficient iron and steel industry. Crude steel production is to be raised to 4,600,000 tons, that is to say more than doubled, and this will affect the chemical industries, through more smelting works, coke ovens, and so forth.

#### Designed by Russians

Probably the most important steel works will be that of Nowa-Huta, near Cracow, largely designed by Russian engineers on the Magnitogorsk and Krivoi Rog pattern and scheduled for completion in 1957. A second large iron and steel works is that of Czenstochau, partly through reconstruction of the former Rakow works, where at least three blast furnaces will be in operation this year; and the plant of Konigshütte (now Kosciuszko-Huta) at Chorzow, is being enlarged. By the end of 1952 a third furnace had been installed. Other extensions include those of the rolling mills at Bobrek in Upper Silesia, and a new steel works in Warsaw, with Russian co-operation. It is understood that another huge plant on the lines of Nowa-Huta is contemplated in the near future. In all these developments special attention is being given to the coking and allied gas and chemical works, for example, ammonium sulphate.

New sources are also needed of sulphuric acid raw materials, hitherto sufficiently furnished from home zinc and lead waste gases and from pyrites and marcasite. But with acid production being increased to 540,000 tons in 1955 (278,000 tons 1949) further sources must be found. These, it is hoped, will be forthcoming partly at least from the expanding lead and zinc ore mining—up to 2,200,000 tons—in the northern and north-eastern borders of the Upper Silesian industrial area, notably in the districts of Beuthen, Tarnowitz, Olkusz and Chrzanow. Zinc production should reach nearly 200,000 tons, and though this is not much above pre-war capacity (170,000 tons), this latter was seldom operated beyond 50 per cent.

A substantial easing, however, of the raw material for acid can hardly be expected from zinc or lead ores alone. A further important source is expected from anhydrite. There are rich deposits of this and gypsum

in the Busko, Chmielnik, and Wislica districts, and in Upper Silesia near Ratibor; also in Lower Silesia in the Lownek and Boleslawiec regions. In June, 1951, a new sulphuric acid plant based on anhydrite was working at Wizow, and a second is being installed at Busko.

Another important branch of the heavy chemical section is of course that based on salt, of which there are inexhaustible supplies in Poland. These with cheap power form a sound economic foundation for a large and progressive alkali industry. Soda ash manufacture will be raised from 228,000 tons in 1949 to 389,000 tons; while caustic will expand from 55,000 to 162,000 tons, including considerable extensions of the electrolytic side, for increasing quantities of chlorine are required for the expanding synthetic industries. Large discoveries of salt deposits have been made in recent years in the Posen and Lodz areas, so that the chief centres have now moved to Hohensalza and neighbourhood.

With regard to other important departments of chemical industry, brief reference may be made to nitrogen, production of which is to be tripled, with new plants in Heydebreck and Gniewoszow, and enlargements at Moscie and Chorzow. In terms of N capacity is to be raised to 230,800 tons, or about 1,154,000 tons of nitrogenous fertiliser. In chemical fibres, marked developments are contemplated for rayon yarn (Zellwolle) and rayon fabric; also the polyamide fibre Steelon, and another called Polan, are to be made in large quantities. The largest of these synthetic fibre factories is at Landsberg-on-Warthe (Gorzow). In 1952 an artificial silk factory started work at Hirschberg. Capacity for cellulose in 1955 is to be raised to 414,000 tons.

#### Organic Dyes Industry

The organic dyes industry is centred in the Lodz and Bielsko regions. With extensions of these and a new factory near Lizajsk total capacity will rise from 3,700 tons to 7,900 tons in 1955. Output of paints and varnishes will be quadrupled, with a large new factory in Breslau. Considerable expansion is planned for wood distillation. Methyl alcohol from this source and synthetically from natural gas will be increased to about eighteen times its 1949 level.



## MIDLANDS SOCIETY FOR ANALYTICAL CHEMISTS

## Precious Metal Assaying

THE third meeting for the present session of the Midlands Society for Analytical Chemistry was held recently in Birmingham. The subject chosen for discussion, 'Precious Metal Assaying—Classical and Modern,' was introduced by Mr. J. A. Hulcoop, Chief Assay Chemist, Messrs. Baker Platinum Ltd. Mr. Hulcoop initiated his lecture with a brief historical introduction, remarking that, as the title included the words Assaying and Classics, it acted as a reminder of the antiquity of the subject.

Assaying was the term used to describe the art of determining the quantity of metal contained in an ore, alloy or metallurgical product by the 'Dry or Fire' method, and its beginnings, so far as gold and silver were concerned were ancient indeed.

According to Smith,\* refining silver by fire was graphically described by Jeremiah in the Old Testament, while a cupellation process for gold was mentioned by Diordorus Siculus as being in use in the 2nd Century B.C.

Continuing, Mr. Hulcoop said:—

Pliny recorded that the Romans used lead in their metallurgical operations for the purification of gold and silver, and the refining of these metals was described by Geber the Arabian and greatest of the early Alchemists, who died A.D. 777.

The exact period at which cupellation was first used for assaying was not accurately known, but conducting assays by the cupel or cupel as it used to be called was practised in France as well as in this country during the 12th Century.

Another method of valuing gold survived from very ancient times and is usually known as the 'touch.' It was used by the Greeks as early as 500 B.C. and was probably devised by the Lydians for testing the quality of their gold coinage. It was originally made on a black stone known as 'Lydian Stone' found in that district of Asia Minor, and the earliest written account of the test is that given by Theophrastus in the 3rd Century B.C.

It is a simple test, although not always regarded as accurate, and consists in rubbing

the gold to be tested on the stone and comparing the colour and behaviour of the streak with similar streaks made with a series of standard gold alloys of known composition, termed 'touch needles.'

The touchstone was well known to the Romans, and was in use in England in the 12th Century and probably earlier. It is certain that this method of testing the quality of gold was also used in the first Government Mint established in Japan in the 16th Century.

The 'parting assay,' in which gold is separated from silver by the action of nitric acid, was certainly known to Geber and the early Alchemists, but the first official mention of its use appears to be in a decree by Phillip de Valois in 1343 confirming its adoption in the French Mint.

## The 'Parting Assay'

In 1666 Samuel Pepys saw the 'parting assay' being practised at the Mint in the Tower of London, and from his description it is clear that the method then employed bears a surprisingly strong resemblance to that of the present day.

With regard to the application of the early methods of assaying to the determination of metals in ores, very little appears to have been recorded. It is not, however, unreasonable to suppose that the ancient process of cupellation originally suggested the idea of fusing precious metal ores with lead or lead compounds to collect and concentrate the gold and silver as a preliminary to cupellation proper.

It would appear that the art of assaying as applied to ores received attention in Germany at a very early date. The methods used by German assayers in the 16th Century were fully described by Ercker in 1574.

Assaying was the earliest known branch of chemistry, and, in fact, the branch which afterwards, through the medium of the various investigations of alchemy, drew attention to theoretical chemistry and thus founded that science.

In order to preserve an historical sequence as well as to make a logical division of the subject, the work that arises out of the historical survey may be briefly considered,

\* E. A. Smith, *The Sampling and Assay of the Precious Metals*.

viz., the assay of gold and silver in ores, alloys, etc.—work which to this day is still carried out by 'fire' or 'dry' methods.

### ASSAYING BY FIRE & DETERMINATION OF GOLD & SILVER

Such assays are carried out on a variety of different materials—ores (often containing extremely small amounts of gold—1 gm. per ton) residues, slimes, lemel bars, jewellers' sweeps, polishings, as well as standard alloys.

In all this work, so far as the fire assay is concerned, there are four main steps:—

- (i) Roasting.
- (ii) Fusion.
- (iii) Scorification.
- (iv) Cupellation.

#### (i) Roasting.

This removes objectionable constituents such as sulphur, arsenic, antimony, and thus renders the ore so treated what is termed 'sweet' and ready for fusion.

#### (ii) Fusion.

This concentrates the gold and silver in a button of lead, while the gangue forms a fusible slag with low melting point fluxes such as sodium carbonate and borax.

#### (iii) Scorification.

This consists in the oxidising fusion of an ore or alloy with metallic lead in the muffle furnace, and has for its object the concentration of the gold and silver in a button of metallic lead and the removal of other worthless constituents by the solvent action of molten litharge formed during the operation by the oxidation of part of the lead added.

#### (iv) Cupellation.

Cupellation serves to remove oxides of base metals such as lead, copper, etc., from the gold and silver which are not oxidisable.

Cupellation is based on the fact that, when molten lead is exposed to the action of air at a temperature considerably above redness it combines with the oxygen of the air to form litharge (PbO), which at the temperature of its formation is a liquid and can, therefore, be drained away into the porous cupel, thereby exposing a fresh surface of lead until the process is finally complete.

There is considerable difference between the surface tension of molten lead and molten litharge; while litharge can 'wet' the surface and hence be absorbed, molten lead cannot do so, or more accurately, only to a limited extent, and hence is not absorbed.

The oxides of lead and bismuth in a state

of purity are the only oxides which possess the property of being absorbed by the cupel, but by the aid of either of these, various other oxides such as copper and nickel, which by themselves are infusible, readily acquire the property of being absorbed.

By means of the appropriate use of some or all of these methods outlined it is possible to collect gold and silver in even the most minute quantities, free from base metals, from almost any form of material in which they may occur. The method is sensitive enough to collect and purify 1 part per million of silver and gold in a sample of 20-30 gms.

For ore work the so-called 'assay ton' system of weighing is largely used in order to facilitate calculation. It is a combination of the AVOIR/TROY/METRIC systems, whereby, based on an assay ton (32.667 gms), each mgm. of gold or silver recovered represents 1 Troy oz. per avoirdupois ton.

With regard to 'parting' as applied to the separation of gold and silver, this depends on the insolubility of gold in nitric acid, and the separation is usually carried out from alloys containing 2½ parts of silver to 1 part of gold, so that the form of the original alloy or 'cornet' is retained intact.

In this manner, using 'proof checks' to trace all the slight vagaries of the method, it is possible to attain an accuracy of 0.01 per cent—0.02 per cent on almost all alloys.

### Method for Hall-Marking

A parting method such as this is, with slight variation, the method by which the various 'Halls' test carat golds for hall-marking purposes. It will, of course, be appreciated that the highest possible accuracy in weighing is absolutely necessary for this class of work. The assay balance with a sensitivity of 0.005 mgms. and maximum loading of 2 gms. is a fine piece of craftsmanship and fundamental to accurate gold and silver work. (There are balances available, of course, which are more sensitive than this and carry a heavier load, but these are not of the assay type.)

In concluding this section of the study, mention may be made of the assay for silver only in silver-rich alloys. In this realm the dry method has been largely superseded and the methods of Gay-Lussac and Vo'hard, or a combination of them, have been largely adopted as giving greater accuracy. When the volumetric/turbidimetric method of



sodium chloride titration, as originated by Gay-Lussac, is carried out under the best possible conditions, it can, with good experience, be accurate in the order 0.01 per cent.

### ASSAY OF THE PLATINUM GROUP METALS

The extensive use of the platinum metals and their alloys and compounds in industry necessitates the assay of a large number of materials, while in addition the assayer has to deal with trade and lemel bars, scrap metal, sweeps, etc., resulting from the working of the precious metals.

The work divides itself into two main groups which must be considered separately.

A. This group is concerned with material such as sweep-residues, scrap bars, etc., containing more gold and silver than platinum and palladium and possibly very subordinate amounts of iridium and rhodium (and possibly osmium and ruthenium).

Preliminary fire assaying, as already described for gold and silver, is essential to eliminate base metals and to concentrate the precious metals in lead, and subsequently in a large silver button of about 3 gms. in weight known amounts of silver being added. From this point the separation of the metals by wet analysis proceeds in orderly fashion along well defined lines. Although different houses may have different preferences, the wet analysis is always based upon parting of the silver button with either sulphuric or nitric acids. This parting removes the bulk of the silver together with some palladium in the case of the sulphuric parting and some platinum and palladium in the case of nitric parting, and leaves the other metals insoluble. These partings are worked up separately by precipitating the silver as chloride and recovering the palladium or platinum palladium.

The main insoluble metals are attacked with dilute aqua regia to dissolve silver, gold, platinum and palladium and leave other metals insoluble. These are separated together with silver chloride by filtration and worked up separately.

The main solution of gold, platinum and palladium in aqua regia is freed from nitric acid by evaporation with hydrochloric acid and the gold precipitated first by means of a mild reducing agent such as ferrous sulphate, oxalic acid, sulphur dioxide, hydroquinone, etc.

The residual platinum, palladium solution is freed from excess precipitant by reduction to metal with hydrazine sulphate, and, after filtration, redissolved in aqua regia and rendered as chloride. At this stage three main methods of separation are available:—

(1) Precipitation of palladium as iodide in the cold with sodium iodide and subsequent precipitation of platinum as ammonium chloroplatinate with ammonium chloride.

(2) Precipitation of platinum as ammonium chloroplatinate in the presence of divalent palladium, and subsequent precipitation of the palladium as iodide.

(3) Precipitation of palladium with dimethylglyoxime in a weakly acid solution followed by precipitation of the platinum after oxidation of surplus glyoxime.

The use of *o*-phenanthroline has been suggested for the separation of palladium from platinum. The precipitate is weighed as the complex and gives an excellent conversion factor for palladium, especially when small amounts have to be separated. However, the comparatively inexpensive dimethylglyoxime procedure has always given satisfactory results and continues to be used. With regard to this latter procedure, it is essential that the precipitated complex be washed with water or dilute acetone rather than pure acetone, otherwise serious solubility errors are incurred. The use of the sodium salt of dimethylglyoxime offers no advantage in this respect, as under the conditions of the precipitation the free dioxime would always be present. *o*-Cyclohexanedionedioxime does not give a precipitate of constant composition and is, moreover, expensive to use.

### Reprecipitation Necessary

In almost all cases reprecipitation of the first precipitate is necessary for the most accurate work, and in the hands of a skilled analyst can give exceedingly accurate results. All the precipitated compounds are carefully ignited to reduce them to metal, and, in the case of palladium, reduced under hydrogen to remove superficial palladium oxide and weighed.

B. The second group of analysis is concerned with alloys in which platinum predominates and may be in association with lesser amounts of any or all of the precious metals, as well as some of the commoner base metals.

As a preliminary to the consideration of this type of assay, three fundamental

features of precious metal chemistry should be mentioned.

(1) The precious metals, with the exception of gold, form complex double nitrites.

The sodium nitrite salts of this type are very soluble in water and stable in feebly alkaline solution, in which base metals are precipitated as hydroxides or basic salts. Sodium nitrite may, therefore, be described as a group reagent for the platinum metals.

(2) The second noteworthy feature is the fact that the tetroxides of osmium and ruthenium are volatile and may, therefore, be separated by distillation. Of the two, osmium tetroxide is much more stable, passing unchanged through hot hydrochloric acid, whereas ruthenium is converted to the trichloride.

(3) A bromate hydrolysis method is applied to the separation of iridium, rhodium and palladium from platinum. The mixed feebly acid chloride solution is diluted and treated with sodium bromate, followed by adjustment of the pH to approximately 7.6. Under these conditions iridium, rhodium and palladium are precipitated as hydroxides together with any base metals, osmium and ruthenium are eliminated as the volatile tetroxides, and platinum remains in solution.

By judicious application of these three main separations, it is possible to carry out complete analyses on the most complex alloys. For example, taking an alloy containing tungsten, copper, iron, nickel, silver, gold, palladium, iridium, rhodium, ruthenium, osmium and with platinum predominating:—

Dissolution in aqua regia followed by evaporation with hydrochloric acid would precipitate the silver as chloride and tungsten as hydrated oxide. These can be filtered off and separated. The main solution would now be subjected to 'nitriton' to separate the base metals copper, iron and nickel as hydroxides and gold as metal. After filtration this mixed precipitate of base metal hydroxides can be dissolved in hydrochloric acid and subsequently separated, thus leaving the gold for determination. The nitrite complexes are destroyed by evaporation with hydrochloric acid. The slightly acid solution is now made strongly alkaline, digested with sodium hypochlorite, and the osmium and ruthenium distilled off in a stream of chloride separated in hot hydrochloric acid and determined.

The distillation flask will now contain platinum, palladium, iridium, and rhodium and traces of ruthenium.

The metals are precipitated from this solution with magnesium alloyed with lead, and dissolved in 20 per cent nitric acid. The solution containing palladium and traces of platinum and rhodium is worked up separately for these metals, the palladium being precipitated with dimethylglyoxime after removal of the lead. The main nitric-insoluble residue is heated at 200°C. with concentrated sulphuric acid containing ammonium sulphate to dissolve the rhodium and some palladium, and these metals are then worked up from this solution. The sulphuric-insoluble residue containing platinum, palladium and iridium, and traces of ruthenium is treated with 25 per cent aqua regia to dissolve the platinum and palladium and leave iridium and ruthenium unaffected. The platinum palladium solution can now be separated with ammonium chloride or dimethylglyoxime, and the ruthenium separated from the iridium by alkaline fusion and subsequent distillation.

It will be appreciated that such a piece of analysis can be rightly called classic, but despite its length and complexity, in the hands of a skilled analyst can provide remarkably accurate results.

#### SOME FEATURES OF PRECIOUS METAL CHEMISTRY OF ANALYTICAL INTEREST

Much investigation has been expended on the use of organic reagents for the precious metals, and particularly platinum and palladium in view of their tendency to form coordination compounds. A large number of reagents for palladium have been noted.

- (i) Dimethylglyoxime and mixed glyoximes.
- (ii) Various aldoximes.
- (iii)  $\alpha$ -Nitroso  $\beta$ -naphthol.
- (iv) *o*-Phenanthroline.
- (v) Thiobarbituric acid.
- (vi) 6-Nitro-quinoline.
- (vii) *p*-Amino-acetophenone.
- (viii) Various diamines.

Of these, dimethylglyoxime is the most generally used, since it gives an excellent separation from platinum.

At the present time, no satisfactory qualitative scheme is available for the analysis of the platinum metals. Such a scheme, especially a microscale scheme, would be

invaluable in teaching institutions where the cost of the materials generally preclude their introduction into teaching courses.

One or two valency considerations as applied to well-known separations may be of interest, since the precious metals occupying transitional position in the periodic table exhibit varying valencies.

Ammonium chloride is a specific precipitant for the hexachloro acids of platinum, iridium and palladium, with which it forms yellow, black, and scarlet precipitates. The hexachloro acid of palladium is unstable, however, being reduced to chloropalladous acid,  $H_2PdCl_4$ , on evaporation with hydrochloric acid. In this form palladium is not precipitated, ammonium chloropalladite being soluble. It will be seen from the foregoing that palladium has a strong affinity for the divalent state and only sustains the tetravalent state in the presence of strongly oxidising agents. This tendency is so marked that even solution of palladium in nitric acid produces palladous and not palladic nitrate.

A similar tendency, but in lesser degree, is shown by iridium which is only precipitated in the tetravalent state. For precipitation of ammonium chloroiridate, it is necessary to evaporate an iridium solution with ammonium chloride in the presence of sodium chlorate.

#### Solubilities Compared

Ammonium chloroiridate is sparingly soluble in water, as is the corresponding potassium salt, but no information is available as to their comparative solubilities. The bromoiridates of ammonium and potassium are more soluble than the chloroiridates, and, accordingly, they offer no advantages for the separation of the metal.

Reference may also be made to the bromate hydrolysis separation cited earlier for the separation of platinum, from palladium, rhodium and iridium.

In the normal mixed chloride solution of these metals they will be present in the following valency states:—Platinum (4), rhodium (3), palladium (2), iridium (3 and 4). The bromate oxidation ensures that all are present in the tetravalent state, in which form all except platinum are precipitated hydrolytically at pH 7.6 in the presence of bromate.

Mention may also be made of the effect of acids on the precious metals. Palladium

alone is appreciably attacked by nitric acid, and palladium and rhodium by hot strong sulphuric acid. Gold, platinum and palladium are soluble in aqua regia, rhodium, iridium, ruthenium and osmium being attacked, unless in a very finely divided state. The normal loss of individuality occurs when these latter insoluble metals are alloyed with platinum in ratios up to 85/15 platinum to metals.

The propensity for complex salt formation exhibited by the precious metals is amazing and is a lifelong study in itself. Most of these numerous compounds are of academic interest only, although the cyanides, double nitrites, amines, and organo-compounds find application in every day chemistry.

#### MODERN DEVELOPMENTS

The methods previously discussed are to be regarded as the classics of precious metal assaying, and have found acceptance wherever such analysis is practised as a day-to-day routine.

It will, however, have been quite obvious that much of this work is necessarily protracted and may be spread over as long as two weeks or more in the case of the more complex alloys. The desirability of quicker separations and determination to meet the demand of modern industrial practice needs no emphasis, and modern research both here and in America has moved rapidly in this direction during the last ten to fifteen years.

Three main lines of research have yielded encouraging results:—

- (i) Spectrographic methods.
- (ii) Spectrophotometric methods.
- (iii) Chromatographic separations.

Many American workers have carried out extensive research on the spectrophotometric procedures, which are now beginning to come into routine operation, e.g.:—

- (a) Platinum by stannous chloride.
- (b) Osmium by thiourea.
- (c) Ruthenium by thiourea and dithionamide.
- (d) Iridium (mixed perchloric, phosphoric and nitric acids).
- (e) Rhodium by hypochlorite.

Published methods covering all these except rhodium are now available in this country and this most useful adjunct to previous metal assaying should prove a boon to the professional assayer.

The general discussion of the Faraday Society on chromatographic analysis held in 1949 showed not only the tremendous interest in this fascinating subject but also that happily the claims of the precious metals have not been overlooked.

This meeting revealed that the Chemical Research Laboratories at Teddington were working on this subject and had achieved considerable success in this field of separation. This work is proceeding and it is confidently expected that satisfactory quantitative separations will soon be available.

### CONCLUSIONS & APPLICATION OF MODERN DEVELOPMENTS

It may be safely assumed that the dry or fire section of precious metal assaying is likely to be a permanent feature for the indefinite future. The work is both accurate, relatively quick, and capable of being organised and handled in large enough batches to suit almost all industrial demands.

The applications of modern research, however, are likely to have the most profound effect upon the separation and determination of the platinum metals as now practised by the classical methods already outlined, gold and silver excepted.

This new technique will come into operation after the dry technique has produced the button containing the concentrated precious metals in silver, or in the case of platinum-rich alloys or simple mixtures, after being rendered in a soluble form either with aqua regia or by conversion to the sodium chloride salts by heating with sodium chloride and chlorine in the furnace. Wherever possible, direct spectrophotometric determinations will be made, as limiting impurities allow, for the respective metals.

In those cases where separation is necessary, it will be effected on the cellulose column, followed by spectrophotometric determination.

This pattern of assaying will represent a very large saving of both time and trouble and with little or no sacrifice of accuracy.

It will be noted that, no mention has been made of the possible applications of polarographic, ion-exchange and radiochemical techniques to the analysis of the precious metals. As far as is known no work has been done on such methods, although there

is no doubt these procedures will be examined in the near future with a view to their application in the precious metal industry.

Electrolytic methods, especially controlled potential separations, are also being examined and there is every hope that these will play their part in the elucidation of the analytical chemistry of the precious metals.

### Sulphuric Acid Plant

THE Power-Gas Corporation, Ltd., has announced the conclusion of an arrangement with Chemiebau Dr. A. Zieren, GmbH., of Neider-Marsberg, Germany, whereby they are able to manufacture and sell a complete range of sulphuric acid plant and associated equipment to Chemiebau designs.

The arrangement with Chemiebau covers processes for the production of sulphuric acid from hydrogen sulphide, sinter gases, sulphur, pyrites, spent oxide, gypsum and other sulphur bearing materials in both vanadium contact and 'intensive' tower type plant.

The arrangement also covers the manufacture of auxiliary and related equipment comprising: vacuum and high concentration plants, mechanical sulphate burners, rotary furnaces, reduction kilns and electrostatic filters for dust and mist precipitation.

The Power-Gas Corporation are accustomed to handling complete contracts for the gas and chemical industries and it is their intention to contract for complete installations including erection and initial operation.

Descriptive literature on this subject is available for firms who are interested.

### Leeds Branch Office

The British Aluminium Co., Ltd., have vacated their branch office and warehouse at 66 Kirkstall Road, Leeds 3, and have transferred the office to Martins Bank Chambers, Vicar Lane, Leeds 1, to handle sales of unwrought and fabricated aluminium alloys in the Counties of Yorkshire and Lincolnshire. Mr. A. E. Hee'ey continues as branch manager, and the telephone number remains Leeds 28343 with telegraphic address, as before, 'Britalumin, Leeds.'

## Fruit & Vegetable Storage & Packaging

### Chemicals Find Increasing Use in U.S.A.

THE use of chemicals as an aid to the successful storage and pre-packaging of fruit and vegetables forms an important part of the report of a British team which visited the U.S.A. in September and October, 1951.

The tour was made under the auspices of the Anglo-American Council on Productivity (now the British Productivity Council) and the Economic Co-operation Administration (now the Mutual Security Agency), and the team comprised representatives of growers, wholesalers and retailers, together with members of the Marketing Division and the National Agricultural Advisory Service of the Ministry of Agriculture.

In the first section, devoted to short-term storage, the report states that experimental work to find a suitable chemical sterilising agent which might be included in the water for washing both fruit and vegetables during their preparation for marketing has been under way for a number of years in the U.S.A.

The purpose of such a chemical steriliser would be to prevent a build-up of contamination within the washing water and also, if possible, to have a prolonged effect in preventing the development of mould or bacterial infection during subsequent handling and distribution.

#### Sterilising Agent Important

Use of a sterilising agent is of particular importance during the process of hydro-cooling, in which the cold water is re-circulated continuously, and also in the washing of vegetables or fruits where the water may perhaps be changed only once a day. Under such conditions there is every chance for cross-contamination to occur and also for a large population of injurious organisms to build up in the water. Even with the thorough pre-cooling and subsequent refrigeration, such organisms may remain viable though in an inactive state.

Of the various materials tried; those generally used are chlorine compounds or free chlorine. The compounds most commonly used are sodium or calcium hypochlorites, which were found to be employed commercially at varying strengths to give when diluted from 50 to about 2,000 parts

per million of chlorine. Concentrations as high as 5,000 to 10,000 parts per million have been found to cause injury to produce. So long as the concentration is not too great, there is also said to be no tainting of produce.

Efficiency of the hypochlorites as sterilising agents is bound up with the alkalinity or acidity of the washing water. In alkaline solutions the chlorine compounds are relatively stable but less effective as sterilisers than when the pH is lowered to give a neutral or slightly acid solution.

Lowering the pH mobilises the hypochlorite ions that are active in disinfection, but accelerates the break-down of the chlorine compounds and results in rapid inactivation of the germicide.

#### Maintained at Neutral Level

It is usually regarded as essential when employing calcium hypochlorites or chloramine solutions to maintain them at a neutral level. Like other oxidising disinfectants chlorine compounds have no residual toxic effect, since the active ions lose their power of disinfection because of reduction.

Proprietary sterilising products are available in the U.S.A. and their use is generally subject to close supervision by the manufacturers concerned, who may employ their own personnel or train personnel at the packing station to operate the plant.

Equipment supplied by one firm is stated to keep the hypochlorite solution at a constant strength by means of an automatic controller, which makes use of a photo-electric cell to take automatic titrations of the water in the supply tank. This controller has two pumps, one of which draws samples of the water into view of the photo-electric cell, which in turn either excites or stops the supply pump replenishing the chemical.

Apart from the use of sodium or calcium hypochlorites, equipment may be installed alongside a washing plant for bubbling nitrogen trichloride gas into the water.

Various other chemical compounds for inclusion in the washing water for fruit and vegetables are being tried and at one packing station in Michigan sodium bisulphite is

being used for washing salads. This chemical, which is also being experimented with as a dust for controlling disease in melons (though not employed commercially for that purpose), has been found to bleach the butts of celery and lettuce but is liable to damage the green parts of the vegetables.

For the control of grey mould and blue mould in apples and pears, the use of sodium chlororhophenyl phenol has been developed in the north-western fruit-producing States. There is a danger that it may cause sickness and dermatitis among those handling it.

### Borax Employed

Borax has been employed for many years in connection with the marketing of citrus fruits. The borax is found most effective in warm solutions. A 3 per cent solution at 110°F. has also been employed for the dipping, for three minutes, of green tomatoes prior to shipping to the northern markets, while a warm 5 per cent borax solution used in trials with cantaloup melons, has been shown to give good decay control. Hypochlorites are also being used with tomatoes, but neither they nor borax will overcome damage from mishandling of the produce.

Apart from the use of chlorine compounds in washing water, chlorine in the form of nitrogen trichloride gas, is employed on a considerable scale in the fumigation of citrus fruits prior to marketing. Use of the nitrogen trichloride to give concentrations of 0.003 to 0.04 parts per million for several periods of approximately four hours each during the de-greening process has been found to result in a significant reduction in the amount of stem end rot and blue and green mould rot developing during the holding and distribution period after packing.

Nitrogen trichloride is employed either in special fumigating stores or in carloads of produce. Since the gas corrodes any instruments such as humidifiers in stores, it cannot be used in those fitted with such instruments or other metal equipment.

One drawback about the treatment is that fumigation takes from one to six hours for citrus, two to three hours for tomatoes and about five hours for melons. It is usual to give one to three fumigations. Since the nitrogen trichloride cannot be stored satisfactorily in cylinders, it is produced on the site by gas generators.

Sulphur dioxide gas is employed as a fumigant for grapes, either in store or in refrigerated transport. One treatment may be given when the wagons are loaded, and subsequent treatments every 10 days afterwards. The gas is dangerous for other products since it causes damage and bleaching.

Use of carbon dioxide during transport to reduce the ripening of fruit is also found valuable from its action in lessening mould growths, including brown rot and blue mould.

The use of wraps impregnated with chemicals such as copper-oxyquinoline is often a commercial practice for the control of grey mould (*Botrytis*) in pears.

Diphenyl-impregnated wraps are employed to a considerable extent in the citrus industry, and this material is also coming into use for impregnating the box liners. When impregnated box liners were tried experimentally for peaches they were found to control brown rot but imparted a distinct off-flavour to the fruit.

Dealing with the storage of particular fruit and crops the report states that work on the gas storage of pears has shown that the storage life of Bartlett's can be doubled by holding in an atmosphere of 5 per cent carbon dioxide and 2 to 5 per cent oxygen at a temperature of 31°F.

In order to prevent the dropping of the leaves of cauliflowers which may occur when held in cold storage, the use of 2,4-D has been developed. It is found that when sprayed with the sodium salt of 2,4-D used at 50 to 100 parts per million with a spreader, cauliflowers will retain their leaves for as long as two months after cutting, but the spray has no effect in preventing yellowing of the leaf or deterioration of the quality of the curd.

### Use of Dry Ice

A considerable portion of the section of the report on the rail and road transport of fresh fruit and vegetables is devoted to the use of dry ice (solid carbon dioxide). This has been developed in the U.S.A. in two directions in connection with the distribution of fresh produce. The first is the long-distance transport of certain fresh fruits, where experimental work has shown the value of the gas evolved during the evaporation of the dry ice. The other is the transport of fresh meats, frozen foods and produce by road, where it is used to a



limited extent on account of its refrigerating effect.

A considerable amount of work has been carried out by research workers of the U.S. Department of Agriculture and others on the use of dry ice during the transport of various fresh fruits to market. It has been shown that fairly high concentrations of carbon dioxide, that is, of the order of 20 to 30 per cent, have proved as satisfactory in controlling the rate of ripening of a number of crops held at moderately high temperatures as have lower temperatures when a normal atmosphere has been employed.

### Rapid Gas Formation

Blocks of dry ice, which weigh 50 lb. each, are wrapped in double heavy paper to facilitate handling and retard evaporation. These are placed a little way below the roof in the centre of the wagon in a space left between the bracing holding the crates of produce in position. The quantity of dry ice used is at the rate of 30 lb. per 1,000 cubic feet of car space to give a concentration of 20 per cent carbon dioxide. In practice, 1,000 lb. of dry ice are placed in a wagon to obviate loss through it not being absolutely gas-proof.

Provided the wagons are fairly air-tight, tests have shown that once the dry ice is placed in position and the doors closed, the carbon dioxide content of the air mounts rapidly, reaching or nearing its maximum in one to two hours.

Even within less than one hour after loading the gas has been found to increase to a percentage that should cause a reduction of rots equal to that resulting from a drop in temperature of 20° to 40°F. The speed with which the action of the carbon dioxide is effective is an important point in its favour.

Though the wagons should be fairly gas-tight, where used for the long-distance transport of perishable produce on journeys taking several days it may be undesirable that a high level of carbon dioxide should be maintained for the whole period, owing to the possibility of the flavour of the produce being adversely affected where a high concentration is maintained for 24 hours or longer. In the ordinary way, however, even with moderately gas-tight wagons, there is sufficient leakage to prevent this.

The wagons for the transport of fresh

produce from California to the northern States, taking 54 days by express goods train, are refrigerated by bunker ice in the normal way, so that any cooling effect of the dry ice is subsidiary to the main purpose of increasing the amount of carbon dioxide in the air, thereby retarding the metabolism of the fruit and reducing the growth of moulds. It is found, however, that the dry ice may reduce the rate of melting of the water ice in the bunkers.

Fruit dispatched under these conditions was examined by the team both in California and New York. Use of pre-cooling, coupled with dry ice and refrigeration in transport, had resulted, the team was told, in a vast improvement in the quality of the produce appearing on the north-eastern markets.

Pre-packaging is the presentation of produce to the shopper in individually-prepared units of sale. A term current in the U.S.A. defines it as the application of the principle of the 'unitisation' of produce. Packaging does not, however, fundamentally change the character of the product packed—it is still a perishable product by contrast with that which is canned, bottled or quick-frozen.

Four main types of transparent-films used for fresh fruits and vegetables are described in the pre-packaging section of the report.

In the first group all the films are made from regenerated cellulose, which may be coated with a lacquer to reduce their permeability to water vapour. This coating has little effect on the passage of air through the film. All are readily heat-sealable, provided they have been specially coated for the purpose.

### Cellulose Films

*P.T. film* is uncoated, allowing free passage of water vapour. The air permeability is, however, relatively low. In contact with liquid water these films become very limp and lose strength.

*L.S.T. and L.S.A.T.* are cellulose films developed in the U.S.A. which are specially coated to reduce the permeability of the films to water vapour as compared with the *P.T.* film. Their permeability to air is hardly affected by the coating but, like that of the *P.T.* film, is relatively low. In the *L.S.A.T.* form the coating adheres firmly to the film, making it resistant to the action

of liquid water. The *L.S.T.* film is not so resistant.

*M.S.T.* and *M.S.A.T.* are films comparable with *L.S.T.* and *L.S.A.F.* respectively in their resistance to the action of liquid water, but the coating used renders them more moisture proof.

#### Cellulose Acetate Film

Cellulose acetate film is similar to the *P.T.* type of regenerated cellulose in that it is not water-vapour-proof. It has a high permeability to air and is resistant to the action of liquid water. Cellulose acetate films are not readily heat-sealed and so require the use of a special or adapted machine employing a solvent, if packages are to be sealed. Wide extremes of temperature and climate have shown the dimensional stability of the film during normal handling, and it has little tendency to tear when used for windows in cartons.

Rubber hydrochloride, the third type, is one of the most effective films as a moisture-vapour barrier, but may be coarse in texture. Addition of a plasticiser increases its pliability and allows the moderate passage of carbon dioxide, and to a lesser extent, of oxygen through it. Properties of the material depend on the amount and type of plasticiser employed: in general, the greater its quantity the more the film will stretch. Films with low plasticiser content are recommended where a high degree of moisture protection is required. The more highly plasticised films are used where greater strength is needed or where their permeability to air is important.

Films of rubber hydrochloride are readily heat-sealable, sealing being accomplished in half a second at 270°F. though they become plastic at the lower temperature of 225°F. The higher temperature is required for an immediate seal. Bags made from this film are not affected by humidity of the atmosphere and retain their stable shape; the more highly plasticised forms of the film are useful for bags made for carrying moderately heavy goods.

At temperatures below 32°F. rubber hydrochloride films tends to become brittle and under such circumstances, as when used for frozen foods, a special highly plasticised form of the film may be employed. Owing to its nature, this film is suitable for stretch wraps (that is wraps stretched and completely covering the article packed).

Films made from polythene, the fourth type, are among the most resistant of any to moisture loss, being comparatively waterproof, and having a low water-vapour transmission rate. The latter is inversely proportional to the thickness of the film. The films are not very readily permeable to gases. They are flexible at low temperatures, down to as low as -76°F.

Polythene is not affected dimensionally by normal changes in temperature or relative humidity, and, being very flexible, it shows great resistance to puncturing. The material generally used in the U.S.A. has a rather cloudy appearance. It is possible to manufacture clear forms of it by a special process, which is employed in Britain. The film is made in flat sheets and also in tube form.

## New Monsanto Division

### To Co-ordinate All Foreign Interests

AS a step to strengthen the participation of the Monsanto organisation in world-wide markets, Dr. Charles Allen Thomas, president of Monsanto Chemical Company, U.S.A., has announced the creation of a new division—the Overseas Division, which will co-ordinate the operations of all of Monsanto's interests outside the United States, including the export sales of Monsanto Chemical Company.

Head of the new division will be Mr. Edward A. O'Neal, Jr., chairman of Monsanto Chemicals, Ltd. Another director of Monsanto Chemicals, Ltd., Dr. W. D. Scott, will be development director of the new division, while Mr. Marshall E. Young, director of the Foreign Department of Monsanto Chemical Company, is to become commercial director.

Although Mr. O'Neal will establish the headquarters of the new division in St. Louis, U.S.A., he will retain his position as chairman of Monsanto Chemicals, Ltd., and will spend a considerable amount of his time in Great Britain. Dr. Scott will likewise remain on the board. Both will continue to take an active interest in the affairs of the British company.

Mr. Harold Driver, secretary of Monsanto Chemicals, Ltd., has gone to America temporarily to assist in setting up the organisation of the new division, the establishment of which is regarded as a significant step forward for Monsanto.



## World-wide Projects

### Record Orders Reported at Power-Gas Annual Meeting

MAJOR contracts completed by the Power-Gas Corporation Ltd., during 1952 included the Indian fertiliser factory at Sindri, Bihar, the largest chemical works in the East with a capacity of 1,000 tons of ammonium sulphate a day; a third blast furnace for the Steel Company of Wales, new furnaces at Vanderbijl Park (South Africa), and Cargo Fleet; and two complete oil mills with a combined capacity of 1,700 tons of seed a week.

These achievements, together with full production throughout the year had been attained despite the difficulties of steel rationing declared Mr. N. E. Rambush, D.Sc. (Hon.), M.I.Chem.E., F.R.S.A., chairman and managing director in his statement at the 53rd annual general meeting of the corporation held in London on 21 January.

Strength of the group lay to a large extent in the variety of fields in which it specialised, covering iron and steel, chemical, gas, petroleum, and edible oil industries. Orders for blast furnaces had predominated during the period under review and contracts had been received which would augment the annual output of pig iron in the United Kingdom by over 1,000,000 tons.

For the chemical industries orders had been obtained mainly in connection with the manufacture of plastics and petroleum chemicals plant. Despite some cancellations due to import restrictions, orders for edible oil plant, mainly for export, had remained at about the same level as previously.

Total orders booked during the year were valued at £7,000,000 and exceeded by more than £1,000,000 the bookings in any previous trading year.

#### Effects of Expansion

Without the additional capacity made available by the company's new works the group's achievement would have been less and its ability to meet the future would have been impaired. It was even possible that the rate of expansion might well have been accelerated, and this point was being investigated by the directors. The new machine shops of Rose, Downs and Thompson in Hull had been completed and designs for new processes were being developed.

The South African and Australian companies were well established and were expanding the field of their activities. Following the chairman's visit to Australia last year the Australian company had purchased new offices in Melbourne and a block of shares in the Perry Engineering Company of Adelaide. Arrangements had been made with the latter company to obtain the use of their manufacturing facilities and the Hon. F. T. Perry, M.B.E., M.L.C., had joined the board of the Australian subsidiary.

While the Canadian subsidiary had not yet been able to trade at a profit, Power-Gas France had made a good start.

#### Hope for New Projects

With the prospects of steel becoming more plentiful it was hoped that many projects held in abeyance during last year would be reviewed, especially the programme of the National Gas Boards. There was every evidence that the demand for blast furnace plant would increase rather than diminish in the years immediately ahead.

It was pointed out that in comparing the consolidated trading profit of £720,870 and other figures with those for 1951 as shown in the accounts, it should be borne in mind that for the purpose of giving a fair comparison with 1952 the 1951 figures had been adjusted to include the full year's results of the Rose, Downs and Thompson companies, which became subsidiaries in the course of that year. The net profit attributable to the parent company for 1952, including its holdings in the subsidiaries was some £37,000 higher than for the preceding year. After careful consideration the board was pleased to recommend the payment of a dividend of 14 per cent, representing a moderate increase over the 12½ per cent paid since 1940.

During the year an invitation to join the board had been extended to Mr. C. E. Wrangham, C.B.E., and had been accepted.

The report and accounts were unanimously adopted, and the retiring directors, Mr. A. H. Lynn, Major W. R. Brown, Mr. L. H. Downs, and Mr. C. E. Wrangham were re-elected.

## Hydromechanics Research

### Progress & Development at Harlow

**S**ATISFACTORY progress and development of the British Hydromechanics Research Association, Harlow, Essex, was reported at its fifth annual general meeting held recently.

During the period under review (October, 1951, to September, 1952), the staff and activities of the association had expanded and the laboratory at Harlow was now fully utilised. The policy of the council of investing the small accumulated capital in setting up and staffing a relatively large laboratory had proved sound. New members had been attracted, and special investigations undertaken with both a financial and a technical profit of general benefit to members.

Equipment under construction included test rigs for reciprocating pump valve research and centrifugal pump research. Accurate volumetric metering tanks were being installed. Much of this equipment had been obtained on advantageous terms, while gifts had been made by members.

About 320 members and visitors had attended the two open days held on 24 and 25 September, 1952 (cf. *THE CHEMICAL AGE*, 67, 463-464), and showed great interest in the progress made at the laboratory since its official opening in the previous year.

One of the items in the research programme which had attracted considerable attention was an investigation, sponsored by the National Coal Board, into the optimum economic condition for the transport of solids in pipe line. While primarily intended for the transport of coal, it was thought that the results might well have other industrial applications.

Other investigations which were being undertaken included:—

Study of the mechanism of cavitation erosion; transient characteristics of centrifugal pumps and flow conditions in impellers; hydraulic friction; the effect of pressure surges on oil pipe line involving lengths of flexible hose both in the laboratory and at an oil refinery; the advantages and limitations of seal packings and joints; minimum pressures in reciprocating pumps and flow through valves at low lifts.

Viscount Waverley, who has been president of the association since its inception, was re-elected to that office, and G. A. Wauchope (Gwynnes Pumps, Ltd.) was re-

elected vice-president. Dr. A. Ivanoff (Hayward-Tyler & Co., Ltd.) continues as chairman with H. Norman G. Allen (W. H. Allen Sons & Co., Ltd.) as deputy-chairman.

## Rivals to Wool

### Synthetic Fibres May Offer Challenge

**T**HE greatest scope for new synthetic fibres appeared to be in invading the wool field, said Mr. A. H. Wilson, F.R.S., research director, Courtaulds, Ltd., speaking on 'Whither Man-Made Fibres?' at the Textile Institute on 30 January. He was delivering the third and final lecture in an inaugural series by Fellows of the Royal Society held by the Institute at its new headquarters in Manchester.

In the past fifteen years, said Mr. Wilson, the competitive position of cellulose acetate had improved relative to that of viscose, partly because of a change in the relative costs and partly because fashion and taste had favoured acetate fabrics.

The advent of nylon had pressed on viscose in the stocking field and would press on cellulose acetate in the warp knitting field, and unless these pressures could be relieved by an increase in exports, large reactions were likely to occur. Considerable efforts would be made to improve the competitive position of each fibre in the nearly saturated silk field by technological improvements and by intensive use-development. It seemed unlikely that, apart from nylon and 'Terylene,' any new synthetic fibres would be established in this field.

Viscose had an effective monopoly of the large tyre cord market and was likely to retain it, though the size of the market was such that every synthetic fibre would attempt to capture some of it.

The level of production of viscose staple fibre must depend to a considerable extent upon the price of cotton and the availability of dollars with which to purchase it, but, particularly in view of the recent very large expansion, it seemed unlikely to increase much more unless improved properties could be imparted to it either by improvements in its manufacture or by blending it with hydrophobic fibres.

The high price of wool made it particularly vulnerable to invasion by the new fibres. To achieve this, formidable technical problems would have to be overcome.

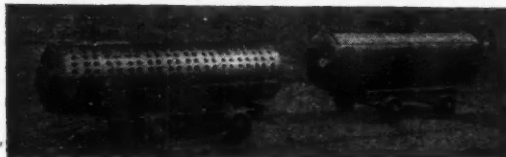
# Metallurgical Section

Published the first Saturday in the month

## Clayton, Son & Co., Ltd.

MOORE END, HUNSLET, LEEDS, 10

Telephone: Hunslet 75226-9  
Telegrams: Gas, Leeds

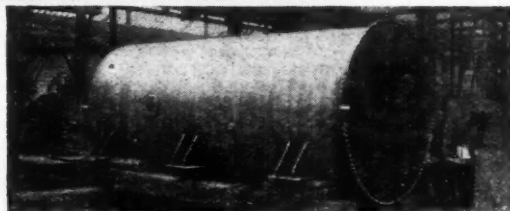


Drums for  
Water Tube  
Boiler

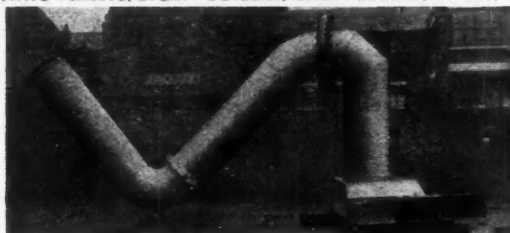
o

Sludge Heater  
for  
Sewage  
Treatment

o



CHEMICAL PLANT, PLATE WORK OF EVERY DESCRIPTION, TANKS, OIL REFINING PLANTS, STEAM BOILERS, GAS-HOLDERS, STILLs, WELDING SPECIALISTS



Large Diameter  
Welded Pipes  
for  
Chemical  
Works

o

Group of  
Mild Steel  
Pressure  
Filters

o



LONDON OFFICE:  
ABBAY HOUSE, 2 VICTORIA STREET, S.W.1

ASHTED 502  
Telephone: Abbey 1754

# T. DRYDEN LTD.

## Complete Laboratory Furnishers

Chemicals and Acids for Laboratory and Industrial Purposes

SCIENTIFIC GLASSWARE AND APPARATUS

THERMOMETERS

HIGHCLASS FURNISHING

PHOTOGRAPHIC CHEMICALS & EQUIPMENT

SOUTH WALES STOCKIST and DISTRIBUTOR OF

PYREX, HYSIL and WOODS' GLASSWARE.  
 WHATMAN, POSTLIP and GREENS' FILTER PAPERS.  
 BAIRD & TATLOCK'S APPARATUS.  
 ROYAL WORCESTER and DOULTON PORCELAIN.  
 A. GALLENKAMP'S SPECIALITIES.  
 FIRECLAY and VITREOSIL WARE.  
 OERTLING & STANTON BALANCES.  
 "ANALAR" ACIDS and CHEMICALS.  
 BRITISH ROTOTHERM TEMPERATURE GAUGES.  
 E-MIL VOLUMETRIC GLASSWARE and THERMOMETERS.  
 "ALDIS" PROJECTORS, EPIDIASCOPES, Etc.

Phone: Swansea 55844/5

**LANDORE  
SWANSEA**



**STAINLESS STEEL**

We are specialists in the manufacture of Bolts, Nuts, Studs and Machined Parts from bar materials, in all classes of Heat-resisting and Stainless Steels.

**THE SANDIACRE SCREW CO. LTD.**  
 SANDIACRE, Nr. NOTTINGHAM  
 Tel: SANDIACRE 2209 — Grams: SCREWS SANDIACRE

## Metallurgical Section

### Zirconium High-Temperature Experiments

#### Problems in the Production of Zirconium Alloys

BECAUSE of its excellent corrosion resistance zirconium metal is likely to become increasingly important, provided that output can be expanded without raising production costs. Numerous methods of production have been tried experimentally or on a small commercial scale. At the U.S.A. Bureau of Mines laboratory, Albany, Oreg., Kroll and his colleagues investigated the production of malleable zirconium by reduction of chloride with fused magnesium under helium. The results of the main investigation have been described in various publications.<sup>1</sup> In 'High Temperature Experiments with Zirconium and Zirconium Compounds,' some of the many sidelines investigated during this work have been reviewed by W. J. Kroll, W. R. Carmody and A. W. Schlecten.<sup>2</sup> Most of the observations made in this report can be applied to the problems involved in making titanium with virtually no change. In general, titanium is easier to reduce than zirconium since its affinities are lower. Its chloride is easier to handle and keep clean because it is a liquid at room temperature.

Direct chlorination of zircon as a method of producing anhydrous zirconium chloride is a one-step operation. A similar process has been used commercially to produce aluminium chloride from bauxite. The chlorination of briquettes made of ground zircon mixed with charcoal and pitch has been described by Alexandrov.<sup>3</sup> To check the work of this author, a series of small-scale experiments were made in which the temperature, the amount of carbon, and the grain size of the zircon were varied. These experiments showed that zircon-carbon mixtures can be chlorinated, but, for a good recovery in a reasonable time, a temperature of about 950°C. and fine grinding of the zircon are required.

Zircon and carbon mixtures are chlorinated directly in the U.S.A. and Great Britain. The German application of direct chlorination has been described.<sup>4</sup>

From this report it appears that, for the same output, the chlorinator needed for the chlorination of zircon must be about five times as large as the one used for the chlorination of carbide, and the zircon must be ground to less than 200-mesh. To facilitate the chlorination the Germans used a large excess of carbon in the mixture and supplied additional heat by mixing oxygen with the chloride. Zirconium losses, when sands are chlorinated, amount to 20 per cent in a plant production of 600 to 800 lb. of  $ZrCl_4$  per day. Chlorination of carbide in a plant capable of producing 300 to 400 lb. of chloride a day yielded 80 per cent of the zirconium input as chloride; 15 per cent remained in residues to be re-treated, and 5 per cent was lost with the waste gases.

#### Larger Carryover

Zirconium losses are higher than when carbide is used, since there is more carryover of zirconium chloride with the much larger volume of waste gases. The raw chloride made directly from zircon contains more oxide, partly in the form of flue dust. The chlorine in the zirconium chloride is only 60 per cent of the total, since silicon chloride is also formed.

In comparing the two processes consideration would have to be given to the cost of arc furnacing in the carbide process and of grinding and briquetting for the zircon-chlorination process. The carbide can be made in a 250 kW furnace with a consumption of about 6 kW-hours per lb. Zirconium losses in carbide production are about 10 per cent. The cost of grinding zircon sand to 200-mesh in the other alternative would be high. Chlorine consumption in carbide chlorination is only 15 to

\* Bureau of Mines Report of Investigations 4915, November 1952.

20 per cent over the theoretical amount needed to produce zirconium chloride. This excess is used to chlorinate the 4 to 5 per cent Si, Fe and Ti present in the carbide. When comparing the advantages of both methods, it would appear that carbide chlorination should be favoured in countries with high salaries and low power costs.

### Three Methods Considered

Three methods were considered for the direct production of zirconium alloys without using metallic zirconium. These were: carbon reduction of zirconium oxide in the presence of the metal with which zirconium was to be alloyed; reduction of a zirconium halide in the presence of the alloying metal; and fusion electrolysis, whereby zirconium metal is plated on a cathode rod composed of the alloying element and melted off as an eutectic.

Preparation of alloys of copper, nickel and iron with zirconium was tested by smelting zirconium oxide and carbon with the selected base metal. A graphite crucible was used, and the reaction was carried out either in a graphite tube-resistor furnace or in a high-frequency furnace. In order to prevent formation of oxides and/or nitrides, the tests were performed in a hydrogen atmosphere.

To produce a zirconium-copper alloy, 300 grams of copper were mixed with 60 grams of zirconium oxide and 12 grams of graphite and heated to 1,800° C. in a graphite resistor furnace. After cooling to 1,200° C., the liquid portion was decanted in air to a mould. This product analysed 2.7 per cent zirconium. A similar test in an open arc furnace yielded an alloy containing only 1.4 per cent zirconium. These results indicate that zirconium oxide may be reduced by carbon to produce a copper-zirconium alloy in a manner similar to the reduction of beryllium oxide to produce copper-beryllium alloys. However, only a small amount of the available zirconium appears in the alloy, the remainder being reduced to the carbide. This method of introducing zirconium in copper does not appear to be practical because the adverse equilibrium conditions between zirconium carbide and the copper-zirconium compound favour formation of the carbide.

In preparing a zirconium-nickel alloy, 50 grams of nickel, 112 grams of zirconium oxide and 21.8 grams of graphite were fused

in a graphite crucible. The zirconium oxide particles did not coalesce with such a small quantity of nickel even at 1,800° C. The mixture was therefore remelted, with an addition of 89 grams of nickel. Analysis of the nickel-alloy ingot showed that it contained 19.3 per cent zirconium and 5.29 per cent carbon. This analysis indicates that all the zirconium in the alloy was present as the carbide. Apparently the affinity of nickel for zirconium is lower than that of zirconium for carbide; as a result, no nickel-zirconium compound is produced in the presence of excess carbon. This test indicates that nickel can be decarbonised with zirconium and that it can be used at very high temperatures as a solvent in the production of zirconium carbide.

To prepare a zirconium-iron alloy, 354 grams of iron, 61 grams of zirconium oxide, and 12 grams of graphite were fused at 1,800° C. The dense, homogeneous ingot produced analysed 9.1 per cent zirconium and 9.71 per cent carbon. The analysis indicates that the zirconium in this alloy was present as the carbide.

In the reduction of zirconium halogenides with metallic reducing agents to produce alloys, only these compounds that form a liquid slag can be expected to be successful; therefore, oxide reductions do not appear promising, zirconium oxide with its melting point of 2,700° C. being too difficult to fuse.

### Successful Reduction

Zirconium alkali double chlorides and zirconium-alkali double fluorides may be reduced successfully if the temperature of the reaction is high enough to fuse the salts but not high enough to volatilise them. The double alkali chlorides of zirconium are fairly stable up to about 800° C. if the zirconium tetrachloride content is kept below 20 per cent. At higher temperatures and concentrations losses occur by evaporation of  $ZrCl_4$ . The principal difficulty encountered in reducing either zirconium double chloride or zirconium double fluoride is formation in the bath of an insoluble, black lower oxide, caused by oxidation of the reduced metal, which lowers the recovery of zirconium. The term 'lower oxide' was given to a new product obtained in the experiments although its chemical nature had not been ascertained.

The copper-rich eutectic of zirconium and copper melts at 980° C. and contains 12.9 per



cent zirconium. A copper-magnesium alloy containing 11.5 per cent magnesium was reacted at 1,000°C. in a graphite crucible with a double chloride of sodium and zirconium containing 9.8 per cent zirconium. The alloy obtained from this reaction contained 2.6 per cent zirconium, corresponding to a zirconium recovery of only 31 per cent. Formation of black sludge and volatilisation accounted for 32.4 per cent of the zirconium. There was still 8.1 per cent magnesium left in the alloy after the experiment, indicating that the end point of the reaction had not been reached.

It is possible that such methods can be used to produce copper-zirconium alloys if special precautions are taken. To eliminate fuming the reaction should be carried out in a sealed vessel, preferably under helium. Zirconium chloride gas should be bubbled into the molten magnesium-copper alloy to avoid contaminating the bath with lower oxide and to increase the zirconium recovery. The quantity of magnesium that will remain in the alloy can be determined by studying the chemical equilibrium involved. It is more economical and simpler to produce copper-zirconium by alloying copper with zirconium sponge obtained by reducing zirconium chloride with magnesium in a helium atmosphere.

#### Suitable Raw Material

A more suitable raw material for producing zirconium-copper alloys would appear to be the alkali double fluorides, because of their low volatility. The melting point of the potassium-zirconium fluoride is about 700°C. This salt contains about 32 per cent zirconium.

Direct reduction of potassium-zirconium fluoride with copper-magnesium alloy did not yield satisfactory results. A coarse powder of copper-magnesium alloy containing 14.7 per cent magnesium was mixed with fused potassium-zirconium fluoride and heated to 1,100°C. in a covered graphite crucible in helium. The resulting alloy contained 8.8 per cent zirconium and 8.4 per cent magnesium. The slag contained 8.3 per cent zirconium. Recovery of the zirconium in the metal was 39.6 per cent, 23.6 per cent remaining in the salt. The calculated loss, mainly as dross, was 36.8 per cent. Addition of a potassium-sodium chloride mixture as a flux appeared to improve the fluidity of the fluoride bath.

but considerable fuming occurred. By adding sodium fluoride, the bath became more fluid, and the recovery of zirconium in the alloy was increased to 52.7 per cent.

#### Sluggish Reaction

Reaction between zirconium double fluoride and the magnesium of the magnesium-copper alloy is sluggish. In a test to speed this reaction, the potassium double fluoride was reacted with a stoichiometric amount of magnesium under helium at 1,100°C. After crushing, this porous reaction product was added to molten copper in a graphite crucible under helium. The zirconium-copper alloy obtained analysed 4.6 per cent zirconium and only 0.07 per cent magnesium. Zirconium recovery in the alloy was 45.5 per cent. This method of producing zirconium-copper alloys appears promising, but it is considered doubtful whether it could compete with direct alloying with zirconium metal sponge.

An attempt was made to deposit zirconium directly into molten copper, which was used as the cathode. Potassium-zirconium fluoride was chosen as the electrolyte and 1.3 per cent zirconium was dissolved in it to avoid anode effect. Electrolysis proceeds at the expense of the zirconium oxide, which is soluble in fairly large amounts in the fused double fluoride. The cell must operate above the melting point of copper. During the run considerable fuming occurred. Therefore, it does not appear practical to combine the electrical reduction and deposition of zirconium into fused copper.

Aluminium-zirconium alloys are readily made by reducing the potassium double fluoride with aluminium. The recoveries are above 90 per cent. Aluminium also reduces zirconia quite well in the presence of cryolite as a solvent for the liberated alumina. In one experiment, 725 grams of aluminium, 100 grams of  $ZrO_2$  and 500 grams of cryolite were fused together in a graphite crucible. The ingot produced contained 7.0 per cent zirconium, which corresponds to a 61.5 per cent recovery of the zirconium.

The report also describes investigations into the reaction of metals with zirconium tetrachloride; chlorine affinities; reaction of metals with potassium-zirconium fluoride; fluorine affinity; plating zirconium alloys on

other metals; and the production of zirconium metal powder.

## REFERENCES

- <sup>1</sup> Kroll, W. J., Schlechten, A. W., and Yerkes, L. A., *Trans. Electrochem. Soc.*, **89** (1946).
- <sup>2</sup> Kroll, W. J., Schlechten, A. W., Carmody, W. R., Yerkes, L. A., Holmes, H. P., and Gilbert, H. L., *Trans. Electrochem. Soc.*, **92** (1947).
- <sup>3</sup> Kroll, W. J., Anderson, C. T., Holmes, H. P., Yerkes, L. A., and Gilbert, H. L., *J. Electrochem. Soc.*, **94**, No. 1 (July, 1948).
- <sup>4</sup> Alexandrov, G. P., *Ukrainian Chem. J.*, **11** (1936).
- <sup>5</sup> Berty, G. H., PB 46980, 46981 and 46979. Supplement to *Fiat. Fin. Report* 774. (PB22626).

## Machining Rarer Metals

THE increasing use of the rarer metals—tungsten, molybdenum, tantalum, titanium, and zirconium—by the rapidly developing modern scientific industries and their greater availability have necessitated the institution of research to establish their optimum machining conditions.

Findings of the tool testing department of Murex, Ltd., Rainham, Essex, have been set out in a booklet in a form designed to be easily assimilated by the engineer.

Contrary to a statement that 'tungsten carbide tools fail (to machine tantalum) because of tantalum's tendency to weld with non-ferrous metals to form carbides' (THE CHEMICAL AGE, **67**, 753), Murex has in fact been using cemented tungsten carbide tools, ('Prolite' grade IC) quite regularly for machining tantalum metal in its own workshops.

In the company's booklet the section on tantalum states that two grades of 'Prolite' cemented tungsten carbide can be used advantageously. For high-speed machining 'Prolite' IC gives the best results, but when sufficiently high speeds are unobtainable 'Prolite' grade 15A gives good results, except that the higher speed range will give better finish and chip formation.

For long tool life and good surface finish a soluble oil coolant should be copiously applied to the cutting edge, the most satisfactory dilution rate being 1-15.

It is emphasised that for maximum finish, high speeds are most advantageous and the importance of lightly honing the cutting edge of the tool with a fine diamond hand lap must not be overlooked.

Recommendations are also included in the booklet for machining tungsten, molybdenum, titanium and zirconium.

## Machine Tool Finish

DISAGREEMENT with some of the recommendations in the report on machine tools made by an Anglo-American productivity team was strongly expressed in a statement issued on 27 January by the Institute of Metal Finishing.

One of the chief criticisms of the Institute is the recommendation that in order to lower prices the British industry should revert to 'war-time' finish both as regards paint work and metal finishing.

The Institute states it should be widely realised that it is essential for machine tools to be well-finished for the following reasons:

1. The finish 'protects the tool against corrosion, and therefore prolongs its life;
2. A smooth paint finish and bright polished plated ware enable the machine to be kept clean and therefore to produce better work;
3. A well-finished machine has a psychological effect on the operator who takes more care of it, increasing its useful life and also producing a better product;
4. In any market a shoddy finish is likely to give the impression of a poor machine and the chances of a sale in competitive markets would be correspondingly reduced.

Return to a 'war-time' finish as proposed—that is a coat of grey paint on an unfilled casting—was likely to have a serious effect on export trade which constituted over 40 per cent of British production. It would furthermore adversely affect the useful life of the machine and probably its productive power.

While such measures were necessary during the war, to revert to them in peace time, in the opinion of the Institute, would most certainly not be in the national interest.

### Japanese Representatives

New Metals & Chemicals, Ltd., of 16 Northumberland Avenue, London, W.C.2, announce that they have appointed Messrs. New Metals & Chemicals Corporation, of Mihara Building, 5 Ginza Higashi 4 Chome, Chuo-ku, Tokyo, as their representatives for Japan. The Japanese business is under the management of Mr. J. Barth, who took up residence in Japan in 1921 and is well known in metallurgical and chemical trade circles there.



# Production of High Purity Lead

## Italian Trials of Sulphamate Method

ONE of the important developments in modern metallurgy is undoubtedly that of producing metals of maximum purity, even up to 100 per cent; for it has now long been realised that the presence of even such a trifling trace of impurity as 0.01 per cent plays a far more important part in determining the physical and chemical properties of a metal than its very low content would appear to justify.

This point was emphasised by R. Piontelli and L. Fagnani in an article describing recent work in Italy on the production and use of super-purity lead by means of a sulphamate bath. (*La Chimie et l'Industrie*, **34**, 629-632.)

In the volume on pure metals edited by A. E. Van Arkel,<sup>1</sup> it is pointed out by W. Schopfer in the chapter on lead, that the properties of this metal in a pure state are even now not clearly known. While references in the literature tend to be contradictory and inconsistent (for example in regard to oxidation phenomena and the existence of allotropic forms), in one direction at least decisive information has been forthcoming, that is from Germany (*loc. cit.*) concerning the excellent quality of electrolytic lead lining in sulphuric acid manufacture.

The possibility of producing high purity lead from the crude on an industrial scale and the potentiality of its various technical uses, has some time engaged the attention of A. Tonoli & Co., of Milan, in collaboration with one of the authors of the article. This work culminated in 1948 with the establishment of an electrolytic process (sulphamate bath), claimed to be the first of its kind in the world, which has since been operating satisfactorily.

### Electrolytic Method Best

From general considerations, including such factors as safe working and uniformity of results, it was apparent that the electrolytic method would be best. Various electrolytic processes are mentioned such as fluoboric, fluosilicate (at Trail, Canada), and perchlorate, but the sulphamate method evolved by Piontelli and his co-workers was finally selected as the most promising.

Sulphamic acid and its salts are highly

soluble and the solutions have optimum conductivity. Moreover the acid is strongly reactive with oxides and hydroxides, which greatly facilitates preparation of the bath, while it is not toxic or otherwise injurious to the skin. It is a crystalline non-hygroscopic solid, and thus easy to store and handle. This compensates the possible advantage of fluosilicic acid in having divalent anions.

Interest taken in the use of sulphamic acid in this field has been emphasised for some time past by R. Piontelli,<sup>2-5</sup> and has been confirmed more recently in Japan by the work of Professor Sakahe Tajima<sup>6</sup> at Tokio University.

### Suitable for Lead Refining

On electrochemical grounds the acid is very suitable for lead refining, especially where numerous metals may be present as impurities.

This is shown by the polarisation curves presented for the different metals in 0.5 M solution as sulphamates. From these it is clearly evident that (1) the really troublesome or dangerous impurities such as bismuth, arsenic, antimony, are practically insoluble; (2) tin forms a very unstable salt (according to anodic and cathodic polarisations, not very definite may be, but clearly superior to those in the HCl bath), (3) while the cathodic polarisation of copper is relatively high, that of lead is extremely low, both anodic and cathodic.

In this connection it is of interest to note, from the prolonged study at Milan University on the electrochemical behaviour of a variety of metals, that the anodic polarisation of lead in the sulphamic bath is the lowest hitherto found for solid metals (excluding mercury).<sup>7</sup> This is illustrated by the comparison of the polarisation curve for lead in the sulphamate bath with those in the perchlorate and fluoborate baths. Present relative scarcity of data prevents fuller comparisons, but it is hoped to provide further information with a new precision apparatus recently introduced by the authors.

Among the practical advantages confirmed by experience are the more uniform action

on the impure anodes and therefore more favourable structure of the anodic deposits and minimum loss of solution therein. It is pointed out that, in the Betts process (Trail), tin acts as if it were an allotropic form of lead, all of which passes into solution at the anode and is deposited at the cathode.

Preliminary tests in the present work had shown the possibility of using with the sulphamate bath anodes containing up to 1 per cent tin without excessive damage to the purity of cathodes; but actually it is not advisable to go much beyond 0.1 per cent. Even so the sulphamate method, despite its superiority to others, is not a conclusive solution of the tin problem without some further modifications.

### Confusion of Ideas

In regard to references in the literature on the subject of hydrolysis of aqueous sulphamate solutions, there appears to be some confusion of ideas on two distinct processes: (a) conversion of the anion  $\text{H}_2\text{NSO}_4$  into ammonium bisulphate; (b) hydrolysis of the sulphamates, the metal hydroxides of which are very weak bases. The first process which is more frequently used, occurs especially in baths of pure acid or rich in free acid, and is strongly accelerated by rise of temperature. In the case of lead it leads to separation of  $\text{PbSO}_4$  and to formation of ammonium ions. The second method, depending essentially on the kind of metal, leads to formation of hydroxide and to corresponding depression of free acid. Practical experience of the past few years has shown that the loss of acid by decomposition is no more than 0.02 kg./ton of Pb cathodes.

The sulphamate bath yields deposits which are mostly macro-crystalline, so that certain additions to the bath are essential to avoid inconvenient changes in structure of the cathodes. It has been found that the additions usually employed such as glue or the like, supplemented by another additive—not specified—form a satisfactory combination.

A few general views are given of the plant at the Paderno Dugnano works of A. Tonolli & Co., Milan, which has already been briefly described elsewhere.<sup>4</sup>

Cells of 1 cu. m. capacity are disposed in cascade of nine cells per unit. The electrolyte contains about 80 g./lit. of lead and

70 g./lit. of sulphamic acid ( $\text{H}_2\text{NSO}_3$ ). Current density is 80 to 120 amp./m.<sup>2</sup> according to quality of anode. Effective yield of cathode current is of the order of 93 per cent (based on a four year average). There has been little or no variation in electrolyte composition. Voltage at 25°C. ranges from 0.35 v. initially to 0.5 v. final, and cathode life is six to eight days. Power consumption is about 140 kWh/ton of cathode. Loss of electrolyte, mostly in the deposits or mechanically, varies according to quality of anodes, but is always within moderate limits.

Purity of the product, without any special precautions, is usually 99.995 per cent, containing traces of Sb, Cu, Bi, Sn. It is noted that, should comparison be made with the Betts process, greater purity is doubtless possible with added refinements. These would, however, necessarily add to the cost and can only be justified if such absolute purity is really required.

Annual production at present is about 10,000 tons ultra-refined lead starting with crude anodes of widely variable composition.

### REFERENCES

- <sup>1</sup> Van Arkel, A. E., 'Reine Metalle,' Berlin (1939).
- <sup>2</sup> Cambi, L., and Piontelli, R., 'Rend. Ist. Lombardo,' 72, 128 (1938); Italian patent 268,824, 15 Dec., 1938.
- <sup>3</sup> Piontelli, R., and Giulotto, A., 'La Chimie et l'Industrie,' 21, 478 (1939).
- <sup>4</sup> Piontelli, R., 'Korrosion u. Metallschutz,' 19 (1943).
- <sup>5</sup> Piontelli, R., and Patuzzi, G. F., 'Metallurg. Ital.,' 34, 215 (1942).
- <sup>6</sup> Piontelli, Proceedings of the 3rd International Conference on Electrodeposition, London, 1947; 'Journal of the Electrochemical Society,' 94, 106 (1948); 'La Chimie et l'Industrie,' 22, 61 (1940).
- <sup>7</sup> Mathers, F. C., and Forney, R. B., 'Transactions of the Electrochemical Society,' 76, 371 (1939); 78, 420 (1940).
- <sup>8</sup> Piontelli, R., 'Ricerca Scientifica,' 11, 276 (1940); 12, 1195 (1941).
- <sup>9</sup> Tajima, S., and Mori, T., 'Journal of the Electrochemical Society,' Japan, 20, 193, 252; (1952).
- <sup>10</sup> Piontelli, R., and Poli, G., 'Gazz. Chim. Ital.,' 78, 717; 79, 10, 214; 535, 635, 642 (1948); 80, 107 (1950).

### American Nickel Project

The Hanna Nickel Smelting Company has signed an agreement with the Government for the production of 95,000,000 to 125,000,000 lb. of nickel in south-west Oregon. The project includes the development of the mine and construction of crushing and drying facilities and a multi-furnace smelter. The smelter will utilise the Uginé process and is expected to be in operation by October, 1955.

# Electrodeposition of Zinc-Tin Alloy

## A Summary of Recent Work in Italy

A GREAT deal of work has been done on the co-deposition of zinc and tin, notably under the auspices of the Tin Research Institute in England, e.g., by R. M. Angles and others. This is briefly reviewed by E. Bertorelle and F. Fogliani as an introduction to a record of their own research in the same field at the Istituto di Chimica, Milan University. (*La Chim. e l'Ind.*, **34**, 639-645).

Tin and zinc can be co-deposited in all proportions from solutions containing sodium cyanide, sodium hydroxide, sodium-zinc cyanide, and free sodium cyanide, operated at 65°C., and at a cathode current density for still solutions of 10-30 amp./ft.<sup>2</sup> (1.08-3.24 amp./dm.<sup>2</sup>), using alloy anodes of the same composition as the alloy to be deposited. The tin content of the solution is maintained at 30 g./lit. and the free cyanide at 17.5-20.0 g./lit. throughout, and the composition of deposit adjusted by varying amounts of zinc, total cyanide and sodium hydroxide. The most serviceable composition from the view-point of steel protection is around 78 per cent tin and 22 per cent zinc. Plate of this composition is not less than 0.0003 in. thick is superior in protective value to either cadmium or zinc plate of comparable thickness; and moreover is extremely easy to solder. With less than 78 per cent tin corrosion resistance of the plate dimensions, but is not seriously impaired until the tin content falls below 50 per cent. Electro-deposition of alloys containing less than 50 per cent tin is much more difficult, and it is probably more economical to apply those alloys by hot

dipping. The tin-zinc plate can be passified by immersion in a hot 2 per cent chromic acid solution, which further increases corrosion resistance and reduces any tendency towards 'finger-marking.' The 78 per cent tin alloy is being increasingly used as an alternative to cadmium.

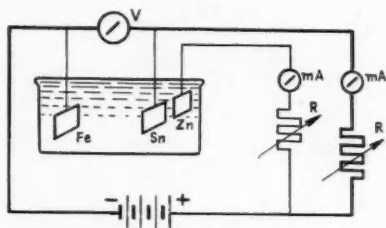
The Italian workers state that it is obvious that a preliminary study of two baths (zinc-plating and tin-plating) each containing free cyanide and NaOH would result in an electrolyte, when the two were mixed, that retained practically intact the characteristics of the two separate baths. A system therefore in which two anodes are used offers definite advantages, e.g., in stabilising very precisely the amount of the two metals in solution, with independent control of c.d. Tests were accordingly made with alkaline baths—cyanide for zinc and stannate for tin—using a glass cell of 16 by 8 by 8 cm., immersed with water-bath in a thermostat to keep the temperature at 65°C. An iron laminate cathode was placed therein, together with an anode, and a stirrer worked by small motor at 80 r.p.m. In the zinc plate bath the area of the anode equalled that of the cathode, but in the tinplate bath it was such as to form the yellowish-green film characteristic of uniform working. It was found that optimum c.d. (cathode) was 1 amp./dm.<sup>2</sup>. The results are tabulated in two tables which may be combined as given below: (A is Zn and B is Sn bath):

Cathode and anode yields were determined by weighing and duration of electrolysis, and analytic bath control was volumetric. In the same cell at 65° the c.d./potential

		I	II	III	IV	V	VI	VII
Zn metal g/lit	.. .. .	2.5	2.5	2.5	2.5	5	11	20
Sn ..	.. .. .	30	30	30	30	40	40	20
Free Na cyanide	.. .. .	A 40 B 40	30 30	30 30	30 30	40 30	50 30	50 30
Na hydrate	.. .. .	A 40 B 40	40 40	23 23	12.5 12.5	40 40	55 12.5	60 23
Cathode yield %	.. .. .	A 21 B 55	23 55	25 60	29 68	35 56	57 67	70 30
Anode yield %	.. .. .	A 100 B 82	100 82	100 79	100 75	100 80	100 74	100 76
Deposit appearance	.. .. .	A good B optim	good optim	good optim	good optim	good ..	good ..	good ..

(cathodic) was determined by the potentiometric method previously described, using baths I, II, III, IV, and the results tabulated and graphed. The two curves Zn and Sn intersect at 0.9 amp./dm.<sup>2</sup> (cathodic), indicating that it is possible to electro-deposit the alloy with the baths described, and to separate, at 0.9 amp./dm.<sup>2</sup>, equivalent amounts of zinc and tin.

In view of the fact that tin is tetravalent and zinc divalent and that the yields of the stannate bath are usually lower than those of the zincate, it is clearly better to operate slightly above the point of intersection of curves. It is also obvious that, by varying c.d., it is possible to modify deposit composition; but it should not exceed 2 amp./dm.<sup>2</sup>, otherwise there is excessive evolution of hydrogen, nor go much below 0.7 amp./dm.<sup>2</sup>, because this would unduly prolong operation. Above 0.9 amp./dm.<sup>2</sup> the tin content increases, and *vice versa* below that point. But there are of course other factors.



The electrical circuit is shown in the accompanying simple sketch, and is no doubt self-explanatory. Further experiments were now undertaken under identical conditions of temperature, stirring, and metal tin content; but contents of zinc, sodium hydrate, free sodium cyanide, and c.d. were varied, as in the following table

	Baths			
	A	B	C	D
Zinc g./lit.	5	2.5	2.5	2.5
Tin	30	30	30	30
Free Na cyanide	40	30	30	30
„ „ hydr.	40	40	23	12.5

The resulting alloy was first of all dissolved anodically from its iron base, and then the tin determined iodometrically and the zinc potentiometrically, the methods being described in some detail, including the weighing. Using a smooth platinum electrode and c.d. of 2.5 amp./dm.<sup>2</sup> (anodic) the

alloy is fairly quickly dissolved, say, in 15-20 min. for a thickness of 15 microns. Results of twelve tests are tabulated, three for each bath, times being 1 or 1½ hr: Current strength: Fe-155-315 mA, Zn-12-90 mA, Sn-105-225 mA. C.d.: Fe-0.8-2, Zn-0.5-5, Sn-0.7-1.5 amp./dm.<sup>2</sup>. Composition of alloy: Zn-15-83 per cent, Sn-16.2-85 per cent. All gave optimum deposits from the point of view of grain-size (fine) and appearance (whitish-gray). It is noted that the total loss in weight of anodes exceeds the weight of the deposits, which is explained as due to the constantly better anodic working compared with the cathodic. But this causes no material change in alloy composition, even after some hours of working, other things being equal. After several days' running the bath may show little change in tin content, a small loss of sodium hydrate and of cyanide, and a slight increase of zinc. Adjustment every few hours with the aid of an auxiliary anode of steel enables the operator to restore the *status quo*.

The results obtained in twelve tests showed that (a) diminution of Zn in the bath leads to higher tin content of alloy, (b) less sodium hydrate means more tin in the deposit, (c) increase of c.d. also causes increased tin content. By varying NaOH or c.d., or both, it is possible to obtain practically all the alloys within the present range, and more particularly those of main interest: 50 per cent Sn and Zn, and 80 per cent Sn. This latter, with maximum protection of base metal, is also most easily soldered. These two alloys are shown in micro-photographs of 1,000 magn. x, the 80/20 being very fine-grained and uniform. Both were obtained in 1 hr. to a thickness of 15 micron. using c.d. of 1 amp./dm.<sup>2</sup>

#### Nearly as Satisfactory

The writers state that electro-deposition of the zinc-tin alloy can also be effected by using, instead of the two separate anodes, anodes of the same composition as the alloy to be deposited, and that this is practically very advantageous; though they do not mention at this point that that is what Angles and co-workers had already done. They suggest some changes in the electrical set-up, e.g., for the 50/50 alloy an anode c.d. of about 3 amp./dm.<sup>2</sup>, and for the 80/20 alloy 5-7 amp./dm.<sup>2</sup> Results are 'nearly as satisfactory as those with separate anodes.'

# HOME

## Agriculture Group Meeting

The next meeting of the Agriculture Group of the Society of Chemical Industry will be held in the Chemistry Lecture Theatre, Royal College of Science, Imperial Institute Road, London, S.W.7, on 17 February, at 2.30 p.m. Dr. A. Eden, of the National Agricultural Advisory Service Eastern Province, Cambridge, will read a paper on 'The Role and Nutritive Value of Unrationed Foods in Animal Feeding.' The paper will be followed by a discussion and tea.

## Saltmakers' Centenary

The Winsford Saltmakers' Association, who are this year celebrating their centenary, have 2,250 members, living mainly in the Winsford, Middlewich and Sandbach districts of Cheshire and at Stafford. About half of them are employed by the I.C.I. Salt Division, the rest by smaller salt making firms.

## 'Bisol' Reductions

British Industrial Solvents, Ltd., have announced reductions in the prices of 'BISOL' methyl acetate and of the 'LOBOSOL' range of low-boiling solvent mixtures, to take effect on and after 2 February, 1953.

The new 10-ton prices, spot or contract, carriage paid in packages returnable at sellers' expense, are:—

Methyl acetate (80 % ester)	£133 per ton (£7 reduction)
Lobosol F.S.	£133 " " (£9 " " )
" M.A.	£96 " " (£11 " " )
" M.T.S.	£95 " " (£10 " " )
" S.S.	£111 " " (£9 " " )

Corresponding reductions have been made for smaller quantities; bulk delivery allowances remain unchanged.

## SCI Symposium

The London Section of the Society of Chemical Industry, together with the Institute of Petroleum, will hold a symposium on 'Production and Utilisation of Petroleum Raw Materials in the U.K. Chemical Industry' on Monday, 2 March, at the Institution of Electrical Engineers. The opening address will be given by Mr. E. J. Dunstan and the symposium will be brought to a close with an address by Sir Robert Robinson, O.M., F.R.S. Further particulars can be obtained from the assistant secretary of the Society of Chemical Industry.

## di-iso-Butyl Phthalate

With effect from 2 February the price of di-iso-butyl phthalate has been reduced by A. Boake, Roberts & Co., Ltd., by 1½d. per lb. The new rates are therefore without engagement as follows:—

10 tons spot or against 6 monthly contract	per lb.
5 tons	1/11½
1 ton	1/11½
40 gallon drum lots	2/-
	2/1

All prices are net including delivery, drums being charged extra but returnable for full credit. Minimum 5 ton deliveries taken in drums are subject to an allowance of £1 per ton. Minimum 1 ton deliveries taken in tank wagon are subject to an allowance of £2 per ton.

## Fertiliser Meeting

The next general meeting of The Fertiliser Society will be held on Thursday, 26 February, 1953, at 2.30 p.m. in the Lecture Hall of the Geological Society, Burlington House, Piccadilly, London, W.1, when the following papers will be read: 'Potash Mining and Production' by L. Garés; 'Potash Utilisation in Agriculture' by G. A. Cowie, M.A., D.Sc., Ph.D., F.R.I.C. The papers will be followed by a discussion. Guests will be welcome.

## Change of Address

The commercial groups of Mullard's Equipment Division have moved to 6 Gate Street, Lincoln's Inn Fields. The general manager of the division, Mr. J. P. Jeffcock, and his immediate staff remain at the company's head office at Century House, Shaftesbury Avenue, London, W.C.2, and all correspondence should continue to be addressed to Century House. The commercial activities of the three product groups—radio, telephone and general electronics—will be centralised at Gate House, under the commercial manager, Capt. R. T. Paul. The telephone number is Chancery 8421 or Gerrard 7777 (via Century House).

## Benzoate Controls End

The Minister of Fuel and Power, Mr. Geoffrey Lloyd, last week announced that he intends to revoke the Order which controls benzoic, toluic and naphthoic.

## OVERSEAS

### Industrial Waste Conference

Scientists from industry and Government will meet at Purdue University, Lafayette, Indiana, U.S.A., on 4, 5 and 6 May to discuss problems connected with the disposal of waste materials which might cause pollution of air or water. Papers will deal mainly with up-to-date information and the progress being made in the disposal of industrial wastes, but some attention will be paid to historical or review aspects. The conference, the eighth of its kind, is open to anyone interested in waste disposal.

### Sarnia Aromatic Refinery

A new refinery for the production of aromatic products including benzene, toluene and xylene, is being constructed at Sarnia, Ontario, by the Nord Chemical Company. Work will be begun in July with a staff of 30 or 40 but on completion in about two years time some 400 personnel will be employed.

### Colombian Fertiliser Company

A new company, which is expected to produce enough ammonia and nitrogen fertilisers and nitric acid to satisfy the country's requirements has been formed in Colombia by the Instituto de Fomento Industrial. The new concern, Compania Colombiana de Fertilizantes, will be established in Barrancabermeja, near the main oilfield and refinery of the Empresa Colombiana de Petróleos. Capital of 20,000,000 pesos will be subscribed by the Instituto de Fomento Industrial, the Caja de Crédito Agrario, Industrial y Minero, the Empresa Colombiana de Petróleos and the Federación Nacional de Cafeteros.

### U.K.-Bolivian Tin Deal

An agreement covering the sale of 50 per cent of Bolivia's tin production has been signed between the British firm of William Harvey & Co. (in which Consolidated Tin Smelters has a controlling interest) and the Bolivian Mining Corporation. Price has been fixed at 121.5 cents per lb. of fine tin delivered New York or 117.5 cents delivered at Chilean ports. The agreement is provisionally effective for three years.

### Polythene in Canada

Canada's first polythene plant, estimated to have cost \$13,000,000 is scheduled to come into operation at Edmonton, Alberta, before the end of this year. Output of polythene from the new plant is expected to be about eight times the amount at present available in the Dominion through imports from Britain and the U.S.A.

### Brazilian Cement Output

Production of cement by the Companhia Brasileira de Cimento Portland Perus, of Soa Paulo, is to be stepped up from the present rate of 300,000 bags a month to 700,000 bags a month by the end of April this year. It is planned to further increase this figure to 1,000,000 bags a month by 1954.

### German Steel Target

An output of 18,000,000 tons of steel is reported to be the 1953 target for Germany's steel industry. This is 500,000 tons more than the aim of the British industry, and if attained would make Germany the third biggest steel producer in the world. Before the war Germany was second largest producer and Russia third.

### New Synthetic Rubber

Goodyear Tyre & Rubber Company has announced basic patents on a new type of synthetic rubber which although similar to the German synthetic rubber 'Vulcollan' has certain advantages over it, according to Dr. Dinsmore, head of Goodyear research. He said that the German rubber must be moulded into the finished article immediately after it is chemically composed, whereas processing of the Goodyear rubber could be delayed. Laboratory testing is said to have shown that tyres made from the Goodyear product have two or five times greater wear resistance than treads made of the best 'cold' rubber produced.

### Aluminium Output in Germany

Domestic production of aluminium in 1952 reached 100,000 tons according to the German Ministry of Economics, and little had to be imported. Unless there is an abnormal rise in consumption the Ministry considers it unlikely that any imports will be required during the current year.



---

## PERSONAL

---

DR. R. J. MORLEY, at present with I.C.I. at their Billingham-on-Tees works, has been appointed Director-General of Carbonisation by the National Coal Board. Dr. Morley, who is aged 40, takes up his new post on 16 March. He was educated at Portsmouth Grammar School and Municipal College and the Royal College of Science, and he joined I.C.I. at Billingham in 1935 where he spent four years as a plant manager and in the research department. In 1940 he went to Canada to advise on the design and management of plant for making ammonia synthesis gas. When he returned to Billingham in 1942 he joined the technical department and in 1949 was appointed ammonia technical manager. He has since been concerned with planning, process design and plant operation problems in connection with steam and electrical plant, coke ovens, gasification processes and with many chemical and pressure processes.

DR. NILS GRALEN, M.Sc., director of research at the Swedish Institute for Textile Research, Gothenburg, professor of textile chemistry at Chalmers University of Technology, Gothenburg, and one of Europe's leading textile scientists, has been elected a Fellow of the Textile Institute. Dr. Gralen, who has undertaken textile research and been a teacher of textile chemistry for several years, has been in close contact with various phases of the textile industry in Sweden and other countries, and has contributed extensively on many aspects of textile research to scientific and technical journals throughout the world.

DR. R. G. FARGHER has joined Samuel Heap & Son, Ltd., dyers, raisers and finishers, Rochdale, as director of technical research and development. He relinquished his position as head of the Technical Processing Division of the British Cotton Industry Research Association in December, 1951, after 30 years' service, but was retained for a further year by the Association as special advisor to the Director of Research.

Simon-Carves, Ltd., announce that three of their directors, MR. D. T. BARRITT, MR.

H. CLARKE, and MR. J. P. V. WOOLLAM, have been appointed joint managing directors of the company.

MR. ROBERT W. LAMONT, director of Watson Laidlaw & Co., Ltd., of Glasgow, sugar, laundry and chemical engineers, has been appointed vice-president of the Glasgow Chamber of Commerce. He is a member of the Scottish executive of the Federation of British Industries and a leading member of trade organisations in the West of Scotland.

MR. HARRY E. CRIVAN, B.Sc., A.R.T.C., A.R.I.C., F.I.M., of Glasgow, has been appointed to the newly-created position of head of the Department of Metallurgy at the Coatbridge Technical College, Lanarkshire. Educated at Allan Glen's School, Glasgow, and the Royal Technical College, Glasgow, Mr. Crivan has had a long experience as a metallurgist in cast-iron, gun-metal, and steel foundries with firms in Amsterdam, Ipswich, Leeds, and Sheffield. Shortly before the outbreak of the last war he joined the staff of the Clyde Alloy Steel Co., Ltd., Motherwell. Four years ago he was appointed lecturer in metallurgy at the Coatbridge College.

---

### Metallurgists' Examinations

The next examinations for the Licentiate-ship and Associateship of the Institution of Metallurgists will be held from 24 August to 1 September, 1953. Applications to enter must be submitted before 1 May, 1953. Details and forms may be obtained from the secretary, the Institution of Metallurgists, 4 Grosvenor Gardens, London, S.W.1. Details of the various centres at which the examinations will be held and other arrangements will be forwarded to candidates in due course. Examinations for the Fellowship of the institution will also be held during the same period. Intending candidates should apply for permission to enter, submitting, for the approval of the council, a statement of the subject of the dissertation or the branch of metallurgy in which they offer themselves for examination.



## Publications & Announcements

SCIENTIFIC work carried out in an art gallery has been the subject of a series of interesting talks given by Dr. A. E. Werner, research chemist at the National Gallery, London. In them Dr. Werner showed that two trends are beginning to take shape. One—the short-term aspect—is devoted to a study of the conservation of paintings and other museum objects. The other—the long-term view—is aimed at increasing the knowledge of materials and techniques of the great masters of classical painting. Thus an attempt was being made to narrow the gap which has separated science and art. The lectures have now been printed as a monograph (1952 No. 4) by the Royal Institute of Chemistry, under the title 'The Scientific Examination of Paintings.'

\* \* \*

'DUSTMEN' to industry for 30 years is the record of Dallow Lambert & Co., Ltd., of Leicester, news of whose new type of unit dust collector was recently released (THE CHEMICAL AGE, 67, 438). This new collector, at first available only in the 100 series, is now also obtainable in the 50 and 150 series. Full details of the whole 'Dustmaster' range together with details of the 'Drytex' (small units), and 'Multiswirl' (wet-type units designed for handling explosive dusts such as magnesium alloys, and embodying special safety features) are contained in the company's latest Dust Control Unit catalogue (No. 25). There is a valuable selection guide giving technical data to assist in the choice of the most suitable unit for particular applications, and also a useful section devoted to accessories.

\* \* \*

PROPERTIES of existing creep-resisting ferritic steels in relation to industrial gas turbine applications are reviewed by H. W. Kirkby, A.Met., F.I.M., in the December, 1952, issue of *Alloy Metals Review*, published by High Speed Steel Alloys, Ltd., Widnes, Lancashire. The author considers that the development of a ferritic forging steel to meet requirements for temperatures of 650°C. or over and stresses of 6-7 tons is likely to prove difficult. One of the technical problems involved is the general inferiority of the ferritic matrix compared with its austenitic counterpart.

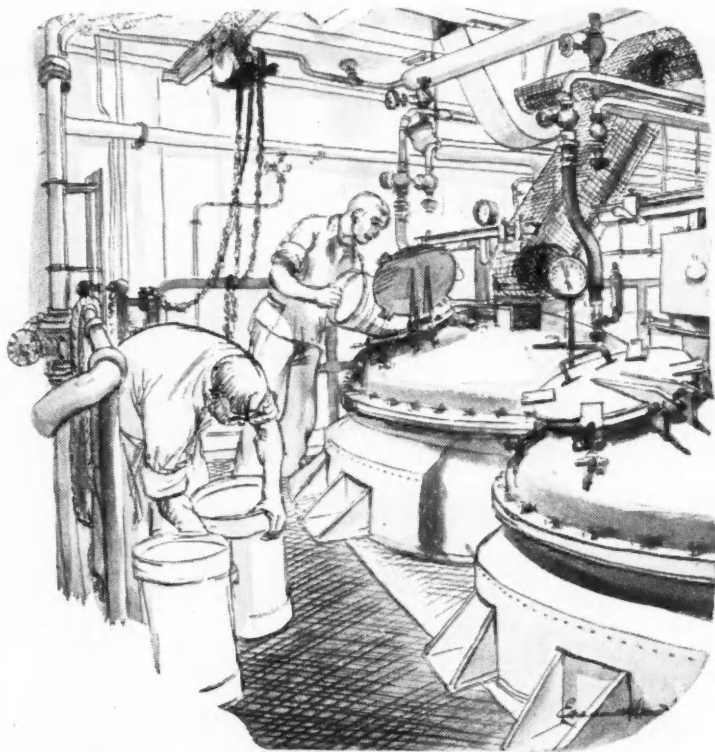
INDUSTRIAL Canada and its vast potentialities is the subject of an article in the series 'Around the World with P.D.' in the January (No. 93), issue of the 'P.D. Review,' a magazine of the activities of Powell Duffryn, Ltd., and its allied companies. Among the variety of interesting topics covered is a brief report about Colonel Harry Llewellyn and his famous horse 'Foxhunter.' Colonel Llewellyn is the son of the late Sir D. R. Llewellyn, Bart., who before his death in 1940, was a director of Guéret, Llewellyn & Merrett, Ltd., Welsh Associated Collieries, Ltd., and Powell Duffryn Associated Collieries, Ltd., now known as Powell Duffryn, Ltd.

\* \* \*

LOW extractability characterises Paraplex G-52, a polymer plasticiser recently made available by the Rohm & Haas Company the properties of which are given in the December, 1952, issue of *Resin Review* (No. 6), published by the resinous products division of the Rohm & Haas Company, Philadelphia, Pa. Other features include a guide to the selection of nitrogenous coating resins entitled 'Which Uformite?' and an article by S. Gusman of the company's application laboratory on 'Test Methods for the Evaluation of Organic Coatings,' in which the newer methods of instrumentation are applied to the measurement of whiteness, adhesion and hardness of protective films and correlation obtained with the older empirical methods.

\* \* \*

THE latest in the series of 'Home Study Books' published by Methuen & Co., Ltd., is 'General and Inorganic Chemistry' by Alexander Findlay, Emeritus Professor of Chemistry, University of Aberdeen, which appeared on 22 January. The series was designed to provide 'new interpretations of modern knowledge for the layman.' In 1949 Professor John Read's contribution 'A Direct Entry to Organic Chemistry' was awarded the Cortina Prize as the best popular scientific book published during the previous five years, and while Professor Findlay may not be similarly honoured, we feel sure that his book will be equally well-received by the general public. Pocket-sized, it runs to 239 pages, includes 12 diagrams, and costs 8s. 6d.



B.D.H. Fine Chemicals for Industry—  
chemicals of laboratory purity—are  
helping many manufacturers to make  
better products than before,  
and to make them more cheaply.

# **B.D.H.**

*fine chemicals for industry*

THE BRITISH DRUG HOUSES LTD.

B.D.H. LABORATORY CHEMICALS GROUP • POOLE • DORSET

TELEPHONE: POOLE 962 (6 LINES) • TELEGRAMS: TETRADOME POOLE

LCP/2

## Next Week's Events

### MONDAY 9 FEBRUARY

#### Society of Chemical Industry

Leeds: The University, 7 p.m. Yorkshire Section. S. W. Butterworth (Birkett & Bostock): 'Technical Research and Development in the Smaller Firm.'

#### Institute of Metals

Glasgow: 39 Elmbank Crescent, 6.30 p.m. R. F. Hudson: 'The Production of Non-Ferrous Castings.'

### TUESDAY 10 FEBRUARY

#### Institution of Chemical Engineers

London: Burlington House, Piccadilly, W.1, 5.30 p.m. S. R. Tailby and Muhammed Aly Saleh: 'Heat Transfer from Luminous Gas Flames in Vertical Tubes.'

#### Institute of Metals

Swansea: University College, Singleton Park, 6.30 p.m. Dr. B. A. Bilby: 'Dislocations in Crystals.'

#### Incorporated Plant Engineers

Manchester: Engineers' Club, Albert Square, 7.15 p.m. 'Instrument Maintenance,' by a representative of James Gordon.

#### Textile Institute

Bolton: Municipal Technical College, 7.30 p.m. H. Sagar (I.C.I., Ltd., Dyestuffs Division): 'Synthetic Fibres—Properties and Processing.'

### WEDNESDAY 11 FEBRUARY

#### Society of Chemical Industry

London: Burlington House, Piccadilly, W.1, 6.30 p.m. Domestic meeting of the Food Group. Dr. N. J. Berridge: 'The Antibiotic Nisin and its Uses in the Making and Processing of Cheese'; Dr. Marie E. Coates: 'The Mode of Action of Antibiotics in Animal Nutrition.'

London: 37 St. Martin's Lane, 7 p.m. Plastics and Polymer Group. Chop supper and informal discussion. C. A. Hughes (director, Siemens Lamps, Ltd., and chairman, Electric Lamp Manufacturers' Association): 'Plastics from the User's Point of View.'

#### Royal Institute of Chemistry

London: South-West Essex Technical College, Forest Road, Walthamstow, E.17, 7 p.m. Dr. K. G. A. Pankhurst: 'The Physics and Chemistry of Detergent Solutions.'

Stockport: The Public Library, 7 p.m. Dr. A. F. Wells (I.C.I., Ltd., Dyestuffs Division): 'Three Dimensional Chemistry.'

#### The Chemical Society

Aberdeen: Robert Gordon's Technical College, 7.30 p.m. Joint meeting with the RIC and SCI. Professor G. E. Blackman: 'Selective Herbicides and the Principles of Selective Toxicity.'

#### Institution of Works Managers

Manchester: Grand Hotel, 6.45 p.m. A. F. B. Nall (assistant technical director, British Standards Institution): 'Standardisation in Industry.'

### THURSDAY 12 FEBRUARY

#### The Chemical Society

Bangor: University College of North Wales, 5.45 p.m. Joint meeting with the Liverpool Section of the Society of Chemical Industry. Dr. R. L. M. Syngé: 'The Protein Requirements of the Ruminant Animal.'

#### Institution of Chemical Engineers

Manchester: Engineers' Club, Albert Square, 3 p.m. North Western Branch. Professor D. M. Newitt (past president), J. F. Richardson, R. H. Clark and D. E. Charles: 'Pneumatic Conveying, Part I—the Pressure Drop During Horizontal Conveyance.' Repeat of a paper delivered in London on 14 October, 1952 (THE CHEMICAL AGE, 67, 567-569).

#### Liverpool Metallurgical Society

Liverpool: Liverpool Engineering Society, The Temple, Dale Street, 6.30 p.m. J. H. O. Varley: 'Nucleation in Metals and Alloys.'

#### Institute of Metal Finishing

Manchester: Engineers' Club, Albert Square, 7.30 p.m. Dr. J. W. Cuthbertson: 'The Electrodeposition of Tin and its Alloys.'

### FRIDAY 13 FEBRUARY

#### Royal Institute of Chemistry

Brighton: The Technical College, 6.30 p.m. Dr. H. Campbell: 'Some Aspects of the Physical Chemistry of Plasma Substitutes.'

#### The Chemical Society

Newcastle-upon-Tyne: King's College, 5.30 p.m. Bedson Club Lecture. Professor

(continued on page 262)

# PERMUTIT

## ION EXCHANGE MATERIALS

Ion Exchange today performs many tasks in industry, and Permutit manufactures a wide range of these materials. Their application in roles distinct from water treatment has resulted in the development of numerous new industrial processes giving improved results and lower running costs. Some of the materials now available, with their characteristics, are shown below.

<b>ZEO-KARB</b>	A sulphonated coal product containing both strong and weak acid groups.	<b>DE-ACIDITE E</b>	A medium basicity high capacity anion exchange material.
<b>ZEO-KARB 215</b>	A nuclear sulphonic acid resin containing also hydroxyl groups.	<b>DE-ACIDITE FF</b>	A very high basicity anion exchange material in bead form suitable for absorption of very weak acids.
<b>ZEO-KARB 216</b>	A resin containing weak acid groups of the carboxyl type.	<b>BIO-DEMINROLIT</b>	For eight years the accepted material for mixed bed demineralisation in a single unit.
<b>ZEO-KARB 315</b>	A sulphonic acid resin particularly stable up to 100°C.	<b>DECOLORITE</b>	A resin of high porosity for removing colour from solutions.
<b>ZEO-KARB 225</b>	A unifunctional, high capacity sulphonic resin in bead form.	<b>RESIN MEMBRANES</b>	For special purposes, many of these materials can be supplied as membranes in the form of rods, discs and thimbles.

With forty years' experience in the manufacture and operation of Ion Exchange materials, the Permutit organisation is continually developing new materials, and new methods of using them. Its Research Laboratory is ready always to co-operate in the solution of your problems.

## THE PERMUTIT COMPANY LIMITED

Dept. V.A. 150, Permutit House, Gunnersbury Ave., London, W.4. Tel.: CHiswick 6431

## Next Week's Events

*continued from page 260*

M. J. S. Dewar: 'The Molecular-orbital Theory of Organic Chemistry.'

St. Andrews: United College, 5.15 p.m. Professor A. Robertson: 'Colouring Matters of Dragon's Blood Resin and Related Topics.'

Southampton: The University, 5 p.m. Dr. J. K. N. Jones: 'The Synthesis of Sugars.'

### Oil & Colour Chemists' Association

Manchester: Grand Hotel, 2.30 p.m. Dr. D. M. Stead and Dr. F. M. Smith: 'Properties of Pigments with Special Reference to Light Fastness.'

## Foundries Draft Regulations

THE Minister of Labour and National Insurance has announced that he proposes to make special regulations applying to iron and steel foundries under Sections 46 and 60 of the Factories Act, 1937.

Towards the end of last year a Private Members' Bill entitled the Foundry Workers (Health and Safety) Bill was introduced into the House of Commons with a view to the improvement of working conditions in iron foundries. The Bill received a Second Reading on 12 December last, but was subsequently withdrawn. In the light of discussions with representatives of interested industrial organisations which arose out of the circumstances attending the introduction and withdrawal of the Bill, the Minister of Labour and National Service has decided to initiate forthwith the statutory procedure for making Special Regulations under the Factories Acts in regard to the subject matters of the Bill, and to extend the scope of the proposed regulations to steel foundries as well as iron foundries.

The draft regulations which are called the Iron and Steel Foundries Regulations, 1953, contain requirements concerning the safety, health and welfare of foundry workers and include provisions as to gangways, the removal of dust and fumes, protective clothing, bathing facilities, clothing accommodation and the stacking and storage of equipment, tools, etc.

Any objections to the draft regulations must be sent to the Secretary, Ministry of Labour and National Service, 8 St. James's Square, London, S.W.1, on or before 31 March.

## Market Reports

LONDON.—A steady demand for home consumers, particularly in the textile, dye-stuffs, and pharmaceutical industries has been reported during the past week. Buying for shipment too has been fairly good despite keen competition.

Price movements have been within narrow limits and in most sections quotations are on a firm basis. Contract delivery specifications for the general run of potash and soda products have covered good quantities. A steady improvement in the demand for the coal tar products seem likely from recent reports.

MANCHESTER.—The demand for heavy chemicals during the past week from leading users in Lancashire and the West Riding, including the textile and allied industries, has again shown a gradually improving tendency, though otherwise the position shows little change compared with what it has been since early in January. In the aggregate a fairly steady trade is being done in the leading lines on home-trade account, while the volume of overseas business has been pretty well maintained. Conditions in respect of the tar products are variable, though on the whole the outlook is somewhat brighter than it was a few weeks ago.

## Imperial College Expansion

AFTER consultation with the University Grants Committee, Mr. Boyd-Carpenter announced on 29 January that the Government has decided to put further resources at the disposal of the University of London for the purpose of major expansion to the Imperial College of Science and Technology.

The intention is to increase the number of students to 3,000 during the five years 1957-62 which will be almost double the present number.

The Chancellor of the Exchequer has invited the college to submit plans based on the assumption that the college will be regarded as having first claim on adjacent land as it becomes available.

This development of Imperial College is in accordance with the Government's policy of building up at least one institution of university rank devoted predominantly to the teaching and study of higher technology.

## Law & Company News

### Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur

#### Mortgages & Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an \*—followed by the date of the Summary but such total may have been reduced.)

**PHILBLACK, LTD.,** Westbury-on-Trym, manufacturers of carbon black. (M., 7/2/53). 1 January, deed varying debenture dated 5 November, 1951, to Martins Bank, Ltd. increasing amount secured from £150,000 (not. ex.) to £250,000 (not. ex.); charged on property charged by said debenture. \*£1,750,000. 28 October, 1952.

#### Increases of Capital

The following increases in capital have been announced:—**ABBOTT LABORATORIES, LTD.,** from £10,000 to £50,000; **GEIGY, LTD.,** from £500,000 to £720,000.

### Company News

#### Laporte Chemicals Ltd.

Private placing of £2,500,000, 5½ per cent debenture stock, 1971-78 at par, through Morgan Grenfell & Co., Ltd., London, has been announced by the directors of Laporte Chemicals, Ltd. Owing to a general fall in demand experienced by the chemical industry production had to be curtailed and there was only a small profit in the six months ended 30 September, 1952. An increase in sales, however, began in the July-September quarter and is continuing. In the case of titanium oxide and sulphuric acid demand now exceeds production capacity. It is difficult to forecast profits for the year ending 31 March, 1953, but if the present trend is maintained the directors anticipate a group figure of £375,000 for meeting bank and debenture stock interest. The previous year's figure was over £800,000. It is not

being assumed that the increase in manufacturing capacity at present being undertaken will contribute substantially to trading results until the year ending 31 March, 1955.

#### Stream-line Filters Ltd.

Regret at the delay in producing the audited accounts for the year ended 31 December 1951, was expressed by the chairman, Mr. C. S. Garland, A.R.C.S., B.Sc., F.R.I.C., M.I.Chem.E., at the 16th annual general meeting of Stream-line Filters, Ltd., held in London on 24 January. The delay was due, among other causes, to the need for finalising as far as possible the proceeds from large running contracts in respect of some of which, even at this late date, reserves had been made on conservative estimates of profit accruing. To maintain regular payment of dividend, a further dividend of 5 per cent had been paid in November 1952. New records were achieved in 1951 both in turnover and in the net profit of £40,572. Dividend had been restored to the pre-war level of 20 per cent, from which it had been reduced in 1940 solely on account of the burden of taxation.

#### Hickson & Welch (Holdings) Ltd.

The directors of Hickson & Welch (Holdings), Ltd., have decided to recommend to the forthcoming annual general meeting a final dividend on the ordinary shares of the company at the rate of 4½ per cent actual in respect of the year ended 30 September, 1952, making with the interim dividend already paid, a total of 7½ per cent for the year. This is the first account of the company since its formation and the net profit of the group realised after allowing for depreciation and taxation is £49,427.

**"Fullersite"** SLATE  
FILLER  
for  
BITUMINOUS PRODUCTS, PAINTS,  
MOULDED RUBBER GOODS,  
PHARMACY, CERAMIC WARE  
apply:—**PENRHYN QUARRIES LTD.**  
Port Penrhyn, Bangor  
N. Wales

# CLASSIFIED ADVERTISEMENTS

## SITUATIONS VACANT

*The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive, or a woman aged 18-59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notifications of Vacancies Order, 1952.*

**ASSISTANT ENGINEER** required by Chemical Engineering Firm in London. Qualifications required are: Age up to 30; B.Sc. or equivalent; good knowledge of physics and heat transfer essential; good mathematics; understanding of chemistry desirable; practical Works' experience essential; understanding of general office procedure and technical sales an advantage. The position offers excellent opportunities to a man having these qualifications coupled with a keen business outlook. Write stating age, qualifications, salary required to Box No. C.A. 3195, **THE CHEMICAL AGE**, 154, FLEET STREET, LONDON, E.C.4.

**EXPERIMENTAL OFFICERS AND ASSISTANT EXPERIMENTAL OFFICERS** in various Government Departments. The Civil Service Commissioners invite applications for pensionable posts. Applications may be accepted up to 31st December, 1953, but an earlier closing date may be announced either for the competition as a whole or in one or more subjects. Interviews will generally be held shortly after the receipt of the completed application form and successful candidates may expect early appointments.

The posts are divided between following main groups and subjects: (a) Mathematical and Physical Sciences, (b) Chemistry and Metallurgy, (c) Biological Sciences, (d) Engineering subjects and (e) Miscellaneous (including e.g. Geology, Library and Technical Information Services).

Age limits: For Experimental Officers, at least 26 and under 31 on 31st December, 1953; for Assistant Experimental Officers at least 18 and under 28 on 31st December, 1953. Extension for regular service in H.M. Forces.

Candidates must have obtained, or be taking examinations during 1953 with a view to obtaining, the Higher School Certificate with Mathematics or a science subject as a principal subject, or the General Certificate of Education in appropriate subjects, or the Higher National Certificate or other specified qualifications. Candidates without such qualifications may be admitted exceptionally on evidence of suitable experience. Candidates over 22 will generally be expected to have higher qualifications.

Inclusive London salary scales: Experimental Officer £628-£786 (men); £533-£655 (women). Assistant Experimental Officers £274-£586 (men); £274-£490 (women).

Starting pay according to age up to 26. At 18, £274; at 26, £495 (men), £467 (women). Somewhat lower rates in the provinces.

Further particulars and application forms from the **CIVIL SERVICE COMMISSION, SCIENTIFIC BRANCH, TRINIDAD HOUSE, OLD BURLINGTON STREET, LONDON, W.1**, quoting No. S84-95/53. Completed application forms should be returned as soon as possible. 20182/260/H.E.

## FOR SALE

**ONE—AUTOMATIC WEIGHING MACHINE**, 1-2½ lb. 14/10 per minute, complete with overhead hopper and agitator. By Automatic Weighing and Packing Machine Co. Seen London. Write Box 52, c/o **WALTER JUDD, LTD., 47, GRESHAM STREET, LONDON, E.C.2.**

## FOR SALE

**CHARCOAL, ANIMAL AND VEGETABLE**, horticultural, burning, filtering, disinfecting, medicinal, insulating; also lumps ground and granulated; established 1830; contractors to H.M. Government.—**THOS. HILL-JONES, LTD., "INVICTA" MILLS, BOW COMMON LANE, LONDON, E.** TELEGRAMS: "HILL, JONES, BOCHURCH LONDON," TELEPHONE 3286 EAST.

*The Well Known*  
**COX & DANKS LIMITED**  
*have for disposal*

**GUN METAL UNIONS** approx. 116 at 2 in., 178 at 2½ in. Misc. quantity **BRASS TEES, ELBOWS, TRAPS, ETC.** 1½ tons **MANGANESE BRONZE TUBING** in two sizes, 1½ O.D. by 1½ in. I.D. and 1½ in. O.D. by 1 in. I.D. lengths 12-14 ft. All items unused and as new.

*Inquiries to*  
**COX & DANKS LIMITED**  
Frederick Road, Salford, 6.  
Telephone: PEN. 2451.

**ECONOMIC BOILERS**—9 ft. diam. by 12 ft. 6 in. Foster Yates, 200 lb. w.p.; 8 ft. diam. by 14 ft. Faxman, 180 lb. w.p. Twenty others, all sizes.

**NEW GALVANISED PIPING**. Immediate delivery. Johnson Filter PRESSES, 25 in., 18 Frame, practically new.

**FIVE NEW FURNACE RETORTS**, 8 ft. diam., 6 ft. 8 in. deep, approx. 8 tons each. Welded Steel.

**BENZOLE WASHER**, lead lined, agitating gear, 7 ft. diam., 6 ft. 6 in. deep.

**FIVE Dish-ended NAPHTHA TANKS**, 18 ft. 6 in. long by 4 ft. 4 in. diam., two having agitators.

**TWO 35 ft. long by 9 ft. diam. Lead-lined TANKS.** Stainless Steel FILTER TANK, 3 ft. 6 in. diam.

**ONE Stainless CONICAL HOPPER**, 7 ft. 8 in. diam., overall depth, 7 ft. 6 in.

**TWO Broadbent WATER-DRIVEN CENTRIFUGES**, 30 in. diam., 12 in. deep, 1,150 r.p.m., 150 lb. pressure.

**FOUR Papier-mache O.T. TANKS**, 8 ft. 3 in. diam., 9 ft. deep. (Unused).

**SIX O.T. TANKS**, 7 ft. diam. 14ft. deep, lined inside with acid-resisting bricks.

**SIX Aluminium CONDENSERS**, 14 ft. long by 2 ft. 6 in. diam. 386 Tubes, ½ in. o.d.

**FOUR Rectangular Lead-lined TANKS**, 8 ft. by 4 ft. 6 in. by 2 ft. 6 in.

**FORTY Riveted RECEIVERS**, 8 ft. 6 in. long, 5 ft. 6 in. diam., 75 lbs. w.p.

**CAST-IRON PIPES**, 5000 ft. Each 6 in. and 8 in. **NEW VALVES** in Stainless, Gunmetal, Knamul Lined.

Free Catalogue, "Watkins Machinery Record," available

**FRED WATKINS, COLEFORD, GLOS.**

**EMULSIFIER** by Hunter, 14-gal. container, 300 lb. w.p., 4 h.p. direct motor drive.

**BOWL MIXERS**, 80-qt., by Peerless and Melvin.

**BOTTLE FILLER**, dual-head vacuum type.

**TRIPLE STEEL ROLLER MILL**, 6 in. by 12 in. rollers.

**VERTICAL DUPLEX PUMP**, steam, ½-2½-6 stroke.

**ROTARY GEARED PUMP**, gunmetal 2 in. delivery.

**ROTARY GEARED PUMP**, 4 in. delivery.

**WELDING'S, SAXONE BUILDINGS, TARLETON STREET, LIVERPOOL, 1.**

**FORGED STEEL PRESSURE VESSEL**, 44 ft. long by 4 ft. 3 in. i.d. by 4 in. thick. **WORKING PRESSURE**, 2,000 lb. p.s.i. **C. W. HOGG, 42, BUSHEY WOOD ROAD, SHEFFIELD.** Telephone: 72777.



## FOR SALE

## MORTON, SON AND WARD LIMITED,

offer  
the following

**ONE**—Stainless Steel Tilting **TROUGH MIXER** by **CHALMERS**. 3 cwt. capacity, motorised. Interlocking lid.

**ONE**—**TROUGH MIXER** by **GARDNER**. 3 cwt. capacity. Stainless Steel lined trough and twin chrome-plated scroll blades mounted on stainless steel shaft. Fast and loose pulley drive.

**ONE**—As above, motorised. Single scroll blade arranged with sifter.

**MORWARD "U"-SHAPED TROUGH MIXERS** in various sizes up to 3 tons capacity with scroll or paddle type mixing gear—jacketed or unjacketed.

**ONE**—New 100g. Glass-lined **JACKETED EVAPORATING PAN** by **PFAUDLER**. 70 lb. p.s.i. w.p. in jacket.

**ONE**—Stainless Steel **MOTORISED AGITATOR**. 5 h.p. geared 200 r.p.m. output, 3-bladed propeller.

**ONE**—Glass-lined **Totally Enclosed RECEIVER** in cast iron. 50g. capacity, with two sight glasses in top.

**ONE**—300g. **COPPER JACKETED BOILING PAN** with stainless steel agitator, direct coupled to electric motor.

**ONE**—500g. **JACKETED AUTOCLAVE** arranged with detachable cover. 150 lb. p.s.i. in jacket, 100 lb. internally.

**WE SPECIALISE IN THE CONSTRUCTION OF ALL TYPES OF MIXING VESSELS MADE TO REQUIREMENTS.**

## HYDRO EXTRACTORS

A large selection of **HYDRO EXTRACTORS**, 72 in., 60 in., 48 in. and 42 in., by **BROADBENT AND WATSON LAIDLAW** available.

**ONE**—600g. Stainless Steel **RECTANGULAR TANK**, 16's gauge, polished inside, mounted in channel iron frame.

## PUMPS

**VARIOUS MONO** and other **PUMPS** in stock, 2 in. to 6 in. new and second-hand, in stainless steel, gunmetal and cast iron.

## INQUIRIES INVITED

MORTON, SON AND WARD LIMITED,

WALK MILL,

DOBCROSS, NR. OLDHAM,

LANCS.

Phone: Saddleworth 437.

**GRAVITY** Roller Conveyor several lengths, Rolls. 2½ in. diam. by 16 in. 3 in. centres. Good condition. **THOMPSON & SON (MILLWALL), LIMITED, CUBA STREET MILLWALL E.14.** (Tel. East 1844.)

**SCREENLESS PULVERIZERS** for fine grinding of chemicals. Also **CYCLONES, ROTARY VALVE FEEDERS**. Callow (Engrs.) Ltd. Kirkby Trading Est., Liverpool.

**SOLVENT RECOVERY PLANT.** 1939 by Sutcliffe Speakeman. 10 G.P.H. 3,500 c.f.m. Complete unit for immediate disposal. **BARGAIN PRICE. BOX NO. 3194, THE CHEMICAL AGE, 154, FLEET STREET, LONDON, E.C.4**

**30 CWT. CHAIN BLOCKS**, 10 ft.-12 ft. lift, ex-Government surplus. £15 per set.

**5 CAST-IRON JACKETED FANS**, 36 in. diam. by 27 in. deep, 1½ in. bottom outlet. £20 each.

**1 MILD STEEL WELDED OPEN-TOP TANK**, 60 in. by 27 in. by 42 in. by ½ in. plate. £25.

**THOMPSON & SON (MILLWALL), LTD., CUBA STREET, MILLWALL, E.14. TEL. EAST 1844.**

## FOR SALE

**3 JACKETED INCORPORATORS**, double "Z" arms, double geared, power-driven tipping motion, with counterbalancing weights.

**1**—Baker Perkins **MIXER** as above, not steam jacketed, single geared, complete with 25 h.p. A.C. motor.

**3**—Baker Perkins and Werner Jacketed **MIXERS** screw tipping pattern, friction pulley drive, single geared, with double-fin type agitators.

**4**—Gardner **RAPID SIFTER MIXERS** and **MIXERS** only, various sizes, one with brass fitted interior and glass-lined end plates.

**27**—Various **POWDER DRESSING** or **SIFTING MACHINES**, totally enclosed with barrels from 80 in. long by 22 in. diam. to 120 in. long by 30 in. diam., belt driven with collecting worm in hopper bottoms.

**1**—Simon Horizontal Tubular **DRIER**, 12 ft. long, 100 lb. steam pressure, size 3B, requiring 12 b.h.p.

**4**—Recessed plate **FILTER PRESSES**, 30 in. square, 70 plates in each, centre feed.

**5**—Johnson **FILTER PRESSES**, 24 in. square, side feed and enclosed delivery, fitted 29 plates and 30 frames.

**1**—Johnson **FILTER PRESS**, 36 in. square, plate and frame type, double inlet and enclosed delivery ports.

Johnson **Oil FILTER PRESS**, Premier type; plates 2 ft. 8 in. by 2 ft. 8 in., of which there are 45, with angle lever closing gear.

**1**—Johnson **FILTER PRESS**, 42 C.I. plates, 32 in. square, centre feed.

Steam-heated **FILTER PRESS**, Premier type, 32 in. square, with 30 recessed plates.

Wood **FILTER PRESS**, fitted 69 ribbed plates, 2 ft. 8 in. square, with top centre feed and bottom enclosed delivery channel.

**1**—24 in. **HYDRO EXTRACTOR**, self balancing, swan-neck type, self emptying bottom.

Heavy **Cake CRUSHING MILL**, 2-pair high, by Nicholson, for cake up to 3 in. thick, rolls 30 in. long, top with coarse teeth 9 in. diam., bottom with finer teeth 12 in. diam.

**5 Sets A.A. CRUSHING ROLLS** for linseed, cotton seed, etc., 48 in. long, belt driven, with feed hopper, side frames, baseplate and striking gear.

Bennett Copper-built **EVAPORATOR**, 4 ft. diam. by 4 ft. 6 in. high, steam-jacketed bottom, mounted on legs, with swan-neck vapour pipe and separate vertical belt-driven vacuum pump.

Douglas **ROTARY PUMP** for oil, soap, etc., belt driven.

**6 Various Horizontal Duplex STEAM PUMPS**, Worthington and Tangey pattern, 1 in. to 2½ in. suction and delivery.

"U"-shaped Horizontal **MIXER**, 8 ft. long, 3 ft. wide, 3 ft. 3 in. deep, belt and gear driven, end outlet, square horizontal centre shaft with cast radial type mixing arms, last used for linseed oil paste.

**1**—"U"-shaped **MIXER**, as above, but 7 ft. long.

**4**—6-roll **REFINERS**, fitted chilled iron, water-cooled rolls, 40 in. long, 16 in. diam., belt and gear driven, with clutch drive suitable for motor, by Baker Perkins Ltd.

**No. 2HS Hammamacc HAMMER MILL**, No. 1 size, Standard Miracle Mill, No. 2 size Standard Miracle Mill and a No. 3 Super Miracle Mill, with fans, piping and cyclones.

**7 ft. Torrance Positive-driven EDGE RUNNER**, 2 Vertical Paint Pug Mills, 2-bar Disc Paint Grinding Mills, and 2 Horizontal 40-gallon capacity Cox Pug Mills for paint.

**1**—No. 1A Water-cooled **CIRCULATOR MILL**.

**RICHARD SIZER, LTD. ENGINEERS, HULL. Telephone 31743**

## FOR SALE

600

## MIXERS

**SIFTER MIXER** by Young, with trough 70 in. by 26 in. by 26 in. deep. Blending chamber feeds material to positive action brush sifter in trough screen. Broken scroll agitator. Pulley drive.

**4 SIFTER MIXERS** by Young, M.S. mixing trough 64 in. by 21 in. by 22 in. deep. Blending chamber feeds material to positive action brush sifter. Fast and loose pulley drive.

**TROUGH MIXER**, 49 in. by 41 in. by 31 in., with twin "Z" mixing blades, fitted counter-balance lid. Motorised 50 h.p. 415/3/50, through reduction gear. Quadrant power tilting gear driven by 5 h.p. motor.

**2 Horizontal Trough PUG MIXERS**, 3 ft. 10 in. by 2 ft. 6 in. by 2 ft. 6 in. deep. M.S. construction. Spiral scraper type agitator, 6 in. outlet worm operated. Hinged steel cover. Fast and loose pulley drive through spur gearing.

**Gardner SIFTER MIXER**, trough 60 in. by 19 in. by 20 in. brush sifter. Spiral type agitator, motorised 440/3/50. Bottom slide discharge.

**Baker Perkins TROUGH TILTING MIXER**. Alloy trough 20 in. by 14 in. by 17 in. deep, with cover. Gunmetal gate-type agitators. Fast and loose pulley drive.

**SIFTER MIXER** by Gardner. Mixing trough 60 in. by 19 in. by 19 in. deep. Ribbon-type agitator. Brush sifter driven through gearing by 2½ h.p. motor, 415/3/50. Bottom gate discharge.

**GEORGE COHEN SONS & CO., LTD.**

WOOD LANE, LONDON, W.12.

Tel.: Shepherds Bush 2070 and

STANNINGLEY, NR. LEEDS.

Tel.: Pudsey 2241.

## PHONE 98 STAINES

**STAINLESS JACKETED GAS-HEATED CYLINDRICAL ENCLOSED MIXER**, 36 in. by 22 in. diam., 400/3/50.

Stainless "GARDNER" MIXER, 5 ft. by 19 in. by 20 in., 400/3/50.

Pair 30 in. (Monel Baskets) HYDROS by "Watson Laidlaw", 400/3/50. Bottom discharge.

Duplex Z-blade and Fin-blade Jacketed and Plain TILTING MIXERS.

**BRAITHWAITE SECTIONAL TANKS**—24,000 and 3,000 gals.; also cast-iron Sectional, Rectangular, Cylindrical and Vehicle Tanks.

Send for lists, Tanks, Mixers, Boilers, etc.

**HARRY H. GARDAM & CO., LTD.,**  
STAINES

## FOR SALE

**30—RETORTS**, 6 ft. dia. by 6 ft. cone shaped lined 2 in. thick porcelain.

**20—Ditto**, unlined.

**52—TANKS**, mild steel, 2 ft. 9 in. dia. by 3 ft. 9 in. lined 2 in. porcelain.

**38—TANKS**, mild steel, 3 ft. 2 in. by 3 ft. 7 in.

**12—TANKS**, mild steel, 4 ft. 6 in. by 3 ft. 3 in.

**4—TANKS**, mild steel, 7 ft. dia. by 14 ft. 6 in. Tile lined for acid, etc.

**2—TANKS**, mild steel, 7 ft. dia. by 5 ft. 8 in. deep.

**1—TANK**, mild steel, 7 ft. dia. by 8 ft. 3 in. deep.

**14—TANKS**, mild steel, 4 ft. 6 in. dia. by 4 ft. 3 in. deep.

**8—TANKS**, mild steel, 4 ft. 6 in. dia. by 3 ft. 4 in. deep.

**10—TANKS**, mild steel, 300/500 galls., Bakelite lined.

**14—HOPPERS**, stainless steel, 4 ft. sq. by 2 ft. 6 in. deep.

**6—SEPARATORS**, stainless steel, 4 ft. by 20 in. dia.

**35—6 in. stainless steel BENDS.**

**MADEN & MCKEE LTD.,**  
317, PRESCOT ROAD,  
LIVERPOOL, 13.

## PATENTS &amp; TRADE MARKS

**KINGS PATENT AGENCY, LTD.** (B. T. King, A.M.I.Mech.E., Patent Agent), 146a, Queen Victoria Street, London, E.C.4. **ADVICE** Handbook, and Consultation free. Phone: City 6161.

## SERVICING

**CRUSHING, GRINDING, MIXING AND DRYING** for the trade.

**THE CRACK PULVERISING MILLS, LTD.**

Plantation House

Mincing Lane,

London E.C.3.

**GLASSBLOWING** by **HALL DRYSDALE & CO. LTD.**, 58, COMMERCE ROAD, LONDON, W.22. Telephone: BOWeS Park 7221.)

**GRINDING** of every description of chemical and other materials for the trade with improved mills. **THOS. HILL-JONES, LTD.**, "INVICTA" MILLS, BOW COMMON LANE, LONDON, E. **TELEGRAMS**: "HILL-JONES, BOCHURCH, LONDON" **TELEPHONE**: 3388 EAST

**WET AND DRY GRINDING** Micronising, Grinding and Mixing of Minerals and Chemicals for all trades. Also suppliers of ground zircon, sillimanite, fused silica, precision casting materials and a wide range of ground minerals.

**W. PODMORE & SONS, LTD.,**

SHELTON, STOKE-ON-TRENT

Phones STOKE-ON-TRENT 2814 & 5475

## WANTED

**INDUSTRIAL BY-PRODUCTS, LTD.**, 16, Philpot Lane, London, E.C.3, will be pleased to receive particulars of any by-products, waste materials and residues for disposal.

## WORKING NOTICES

**THE** Proprietors of Patent No. 596,121, for "IMPROVEMENTS IN OR RELATING TO PURIFICATION OF CELLULOSE MATERIALS," desire to secure commercial exploitation by licence in the United Kingdom. Replies to **HASELTINE LAKE & CO.**, 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2.

**IT** is desired to secure the full commercial development in the United Kingdom of **BRITISH PATENTS NOS. 612,806, 612,807 and 612,808**, which relate to "ZINC RESINATES AND ZINC CALCIUM RESINATES AND PRODUCTS RESULTING THEREFROM," either by way of the grant of licences or otherwise on terms acceptable to the Patentee. Interested parties desiring copies of the patent specifications should apply to **STEVENS, LANGNER, PARRY & ROLLINSON**, 5 to 9, QUALITY COURT, CHANCERY LANE, LONDON, W.C.2.

**Merthyr Tydfil Ceramics Ltd.,**

Manufacturers of

**ACID RESISTING**

**LOW POROSITY**

**TOWER PACKING RINGS**

Sizes ½ inch to 4½ inches.

Office & Works:—

Heolgerrig, Merthyr Tydfil, Glamorgan.

Telephone:—Merthyr Tydfil 793

Sale  
AN  
Tel.

# SULPHATE of ALUMINA

ALL QUALITIES

THE  
ALUMINA COMPANY, LTD.  
IRON BRIDGE  
CHEMICAL WORKS,  
WIDNES

Telephone                      Telegrams :  
WIDNES 2275 (2 lines.)      ALUMINA, WIDNES

## Trichlorethylene

Available for  
prompt shipment

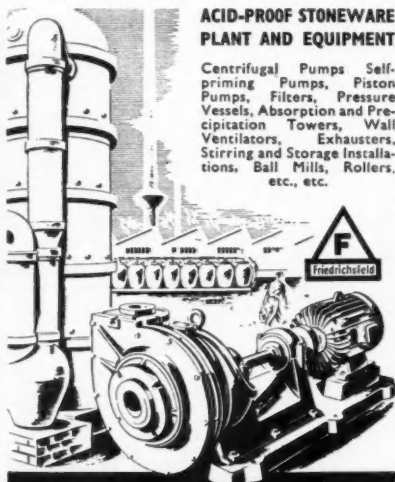


A Harris & Dixon Company  
**Guest Industrials Ltd.**  
Raw Materials Division

81, Gracechurch Street, London, E.C.3  
Telephone : Mansion House 5631 (16 lines)  
Telegrams : Guestind. London

### ACID-PROOF STONEWARE PLANT AND EQUIPMENT

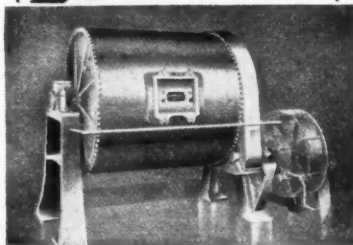
Centrifugal Pumps Self-priming Pumps, Piston Pumps, Filters, Pressure Vessels, Absorption and Precipitation Towers, Wall Ventilators, Exhausters, Stirring and Storage Installations, Ball Mills, Rollers, etc., etc.



**DEUTSCHE STEINZEUGWARENFABRIK  
MANNHEIM - FRIEDRICHSHELD**

Sole Representatives for Great Britain :  
ANDERMAN & CO., LTD., 31 TOOLEY STREET, S.E.1  
Tel. : HOP 0035-6 & 1169 Grams : Deran, Phone, London

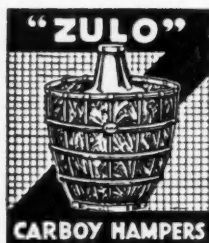
# BOULTON



**Ball & Pebble Mills**  
ALSO RELINING IN PORCELAIN, STEEL, ETC.

**WILLIAM BOULTON LTD.**  
PROVIDENCE ENGINEERING WORKS  
BURLINGHAM - STOKES-ON-TRENT

PHONE: STOKES-ON-TRENT 873411 LINES 1 TELEGRAMS: BOULTONS BURLINGHAM



**LEIGH  
& SONS  
METAL  
WORKS**

Orlando LTD.  
St., BOLTON

**CARBOYS: PACKED CARBOYS,  
CARBOY FILTERS AND BARROWS.  
SAFETY CRATES TOP PROTECTORS.**

## Solvent Recovery Plant

### Carbon Adsorption System

**British Carbo-Norit Union, Ltd.  
176, Blackfriars Rd., London, S.E.1**

## SPECIALIST ENGINEERS TO THE CHEMICAL AND ALLIED TRADES

**WOODEN VATS, DRUMS and PADDLES  
PUMPS of various types  
DRYING MACHINERY  
CHOPPING and CRUSHING MACHINES  
AGITATING and DISSOLVING VATS  
STAINLESS STEEL DRYING TRAYS  
HANGING CLIPS for skins and leather board  
SPECIAL PURPOSE MACHINERY**

**EDWARD WILSON & SON LTD.**  
Aintree Road, Bootle, Liverpool, 20

Telephone :  
Bootle 2291/2

Telegraphic Address :  
Motion, Liverpool 20

## PUMPS

**CENTRIFUGAL ROTARY DIAPHRAGM  
—  
PETROL-DRIVEN ELECTRIC HAND  
—  
NEW & RECONDITIONED  
—  
SALE OR HIRE**

**THE GREENWICH PUMP & PLANT  
Co. Ltd.**

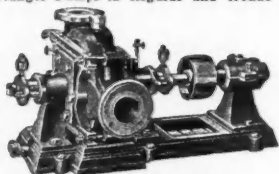
DENHAM STREET, GREENWICH, S.E.10  
Telephone: Greenwich 3189

## SPECIALISTS IN BULK LIQUIDS TRANSPORT

**Acids • Oils • Spirits  
and General Chemicals**

**Harold Wood & Sons, Ltd.**  
Booth Street, Cleckheaton, Yorks  
Telephone: **CLECKHEATON 1126** (3 lines)  
Telegraphic Address: "Transport Cleckheaton"  
London Office: 411 OXFORD STREET, LONDON, W.1  
Telephone: Mayfair 6060

For all kinds of Acid Lifting, Haughton's Centrifugal  
and Plunger Pumps in Regulus and Ironae Metal



Send for Illustrated List

**HAUGHTON'S METALLIC CO. Ltd.**  
30, ST. MARY-AT-HILL, LONDON, E.C.3

## KEEBUSH

Keebush is an acid-resisting constructional material used for the construction of tanks, pumps, pipes, valves, fans, etc. It is completely inert to most commercial acids; is unaffected by temperatures up to 130°C; possesses a relatively high mechanical strength, and is unaffected by thermal shock. It is being used in most industries where acids are also being used. Write for particulars to—

## KESTNER'S

5 Grosvenor Gardens, London, S.W.1

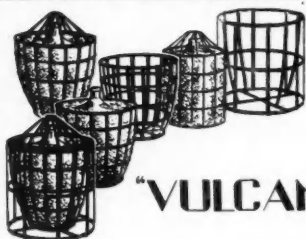
## COLES MOBILE CRANES

Authorised Coles Crane Repairers offer competent and immediate service facilities. Most Spares available from stock. Conversions undertaken from screw derrick to rope derrick. Incomplete cranes or wrecks rebuilt, or purchased.

## CRANES FOR SALE OR HIRE

**DERBY AVIATION, LTD.,**  
Derby Airport

**BURNASTON** **Nr. DERBY**  
Telephone: Derby, Etwall 323-4



"VULCAN"

CARBOY HAMPERS  
SAFETY—CRATES  
PACKED CARBOYS

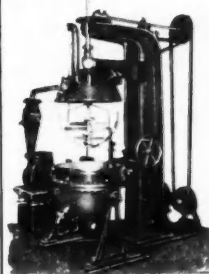
**HARRIS (LOSTOCK) LTD**  
LOSTOCK GRALAM. NORTHWICH

"VULCAN" LOSTOCK GRALAM. NORTHWICH 2954



## COPPER PLANT

for the CHEMICAL TRADES



Steam jacketed copper Boiler and Mixer to tilt, with vacuum pump, and jet condenser. Cover and agitator raised by bevel gear and hand-wheel.

STILLS  
RECTIFYING  
COLUMNS  
CONDENSERS

Autoclaves  
Calandrias  
Vacuum Pans  
Boiling Pans

Pipework,  
Coils, etc.

ESTABLISHED 1825  
**BLUNDELL & CROMPTON**  
LIMITED

WEST INDIA DOCK RD., LONDON, E.14  
Phone: East 3832 (2 lines) Grams: Blundell  
5-1455 Phone: London

## CONSTRUCTIONAL ENGINEERING

FOR  
THE  
CHEMICAL INDUSTRY

STRUCTURAL  
STEELWORK  
STEEL  
CHIMNEYS  
ETC.

RIVETTED  
& WELDED  
STEEL PLATE  
FABRICATIONS  
ETC.

**B. GETTINGS & SON**  
BOROUGH ENGINEERING WORKS  
HARE STREET • BILSTON

Phone: BILSTON 41325  
Grams: 'GETTINGS,' Bilston

## 40 GALLON STEEL DRUMS

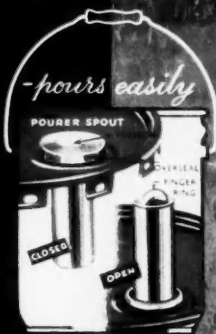
Thoroughly Reconditioned  
Suitable for all trades

**GEO.W. ORR & Co. Ltd.**  
8 COUSTONHOLM ROAD,  
GLASGOW, S.3.

Telegrams  
Containers, Glasgow.

Telephone:  
Langside, 1777.

# THE *Metal Containers* PAIL



With its hermetic, liquid-tight closure and reduced bottom for ease of stacking the Metal Containers Pail can in addition be equipped with standard fittings such as a press-cap to be used when packing liquids. Capacity range at present is from 2-13 gallons.

METAL CONTAINERS LTD., 17 WATERLOO PLACE, PALL MALL, LONDON  
WORKS: ELLESMERE PORT AND RENFREW. ASSOCIATED COMPANIES OVERSEAS

Printed in Great Britain by THE PRESS AT COOMBELANDS Ltd., Addlestone, and published by BEX'S BROTHERS LTD., at Bouverie House, 154, Fleet Street, E.C.4. 7 February, 1953. Registered at the General Post Office. Entered as Second Class Matter at the New York, U.S.A., Post Office.



DON  
RSEAS

US  
P.